Environmental Impact Assessment

PROPOSED PRINCESS HOTELS AND RESORTS DEVELOPMENT, COVE, HANOVER, JAMAICA

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Submitted by:	CL ENVIRONMENTAL ENVIRONMENTAL CONSULTANTS
Submitted to:	INCO LAND LIMITED COVE, GREEN ISLAND, HANOVER, JAMAICA

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED PRINCESS HOTELS AND RESORTS DEVELOPMENT, COVE, HANOVER, JAMAICA

Submitted to:

INCO LAND LIMITED

Cove, Green Island

Hanover, Jamaica

Submitted by:

CL ENVIRONMENTAL CO. LTD.

20 Windsor Avenue

Kingston 5

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INTRODUCTION

Princess Hotels and Resorts Limited has acquired approximately 73 hectares (180 acres) of land in Green Island, Hanover and is desirous of constructing a 2037-room eco-resort on approximately 34 hectares (≈ 84 acres) of it. This will consist of a combination of four (4) separate hotel blocks, fourteen (14) overwater searooms and a Casino. The proposed hotel property is located in Green Island, Hanover. The site shoreline is approximately 2.3 km in length consisting of rocky shoreline, sandy beach, and a mangrove coastline in some areas.

This development fits into the Governments' drive of increasing tourism arrivals, diversifying the locations of tourism infrastructure from the traditional areas of Negril, Ocho Rios, Montego Bay, Port Antonio and Kingston and increasing the tourism offerings. With the Governments' drive of increasing tourism arrivals there's a concomitant increase in hotel rooms to accommodate the expected stop over visitors. The proposed project complies with Vision 2030; the National Vision Statement - *"Jamaica, the place of choice to live, work, raise families, and do business".* A part of the vision is that; we are the premier destination to visit and do business. This proposed development will increase the room offerings of the island, thereby growing the clientele and in the process enhance the Jamaican tourism product.

PROJECT DESCRIPTION

Princess Resorts will create a combination of four (4) separate hotel blocks, fourteen (14) overwater searooms and a casino. Each hotel will serve a different clientele, from adults only packages to family fun parks and public beach clubs.

<u>Hotel:</u>

The Resort's four hotels will be in the "5 STARS GRAND LUXURY" category and will be built in two phases. In each phase, there will be two hotels that share the service area, making the plot ratio of the land and its environmental impact much lower, because operationally they will work as a single hotel. This means that for each phase (2 hotels) there will be one centralized kitchen, one industrial area, one warehouse area, one personnel area etc. In each phase, one of the two hotels will be "Adults Only", with the objective of differentiating and diversifying the product.

The Resort, with a total of 2,037 rooms can be broken down as follows:

PHASE I **1,012 Hotel Rooms**

HOTEL I. 422 Rooms

HOTEL II. 590 Rooms

PHASE II **1.025 Hotel Rooms**

HOTEL III. 590 Rooms

HOTEL IV 435 Rooms

HOTEL 1 (Adults)

JUNIOR SUITE A	84
JUNIOR SUITE A - Swim Up Pool	252
JUNIOR SUITE B	14
JUNIOR SUITE B - Swim Up Pool	42
JUNIOR SUITE C	1
JUNIOR SUITE C - Swim Up Pool	3
JUNIOR SUITE D	1
JUNIOR SUITE D - Swim Up Pool	3
SUITE A	4
SUITE B	4
SEA ROOM	14
TOTAL	422

HOTEL 2 (Families)

STANDARD ROOM A	198
STANDARD ROOM A - Swim Up Pool	70
STANDARD ROOM B	216
STANDARD ROOM B - Swim Up Pool	75
JUNIOR SUITE A	6
JUNIOR SUITE A - Swim Up Pool	2
JUNIOR SUITE B	12
JUNIOR SUITE B - Swim Up Pool	3
JUNIOR SUITE C	3
JUNIOR SUITE C - Swim Up Pool	1
SUITE A	3
SUITE A - Swim Up Pool	1
TOTAL	590

HOTEL 3

STANDARD ROOM A	342
STANDARD ROOM A - Swim Up Pool	120
STANDARD ROOM B	-
STANDARD ROOM B - Swim Up Pool	-
JUNIOR SUITE A	-
JUNIOR SUITE A - Swim Up Pool	-
JUNIOR SUITE B	87
JUNIOR SUITE B - Swim Up Pool	29
SUITE A	9
SUITE A - Swim Up Pool	3
SUITE B	-
SUITE B - Swim Up Pool	-
SUITE C	-
SEA ROOM	-
TOTAL	590

HOTEL 4 (Adults)

STANDARD ROOM A	132
STANDARD ROOM A - Swim Up Pool	50
STANDARD ROOM B	117
STANDARD ROOM B - Swim Up Pool	31
JUNIOR SUITE A	3
JUNIOR SUITE A - Swim Up Pool	1
JUNIOR SUITE B	60
JUNIOR SUITE B - Swim Up Pool	20
SUITE A	12
SUITE A - Swim Up Pool	4
SUITE B	-
SUITE B - Swim Up Pool	-
SUITE C	5
SEA ROOM	-
TOTAL	435

With this number, category and type of hotels we get to lower the density of the Resort, making it more sustainable, exclusive and luxurious. The service areas will be concentrated in three levels in order to reduce the amount of land to be used, also the common areas of the hotels that are proposed in three levels with the same objective. The facades of the buildings will have porches that will cause these to merge with the outside creating spaces of natural and ecological ventilation. The hotels will have all the rooms with sea views.

Searooms:

Fourteen (14) searooms will be built to the eastern end of the property. The utilities will be supplied from the main Hotel property and will be routed under the boardwalk in watertight piping.

Casino:

A casino will be designed as an independent building inside the Resort, separated from the hotels, with its own access and vehicle parking area. The casino building will be of two floors and will have a double-lane Lobby Motor and a very contemporary and ecological façade based on green walls that integrate perfectly with the Protected Area that surrounds it. On the ground floor there will be the casino reception and play area which will be approximately 2,000m^2, with toilets, a bar and an administration area.

Water Storage Tank:

A tank will be built to meet the needs of drinking water and firefighting. The water reserve (tank storage) will be 3 times the demand for the total 2037 Rooms (Phase 1 of 1012 Rooms and Phase 2 of 1025 Rooms). The tank will be used for: (i) production process; (ii) human use in the event of an emergency; (iii) fire extinguishing purposes. The fire pump extraction points are installed at different heights to ensure its exclusive use for fire extinguishing purposes and, moreover, this system allows use of the total tank capacity in case of fire. In case of fire, the system ensures the necessary flow rate supply for a minimum of 30 minutes (Level of Risk=Medium).

Wastewater Treatment Plant:

A wastewater treatment plant will be located on Lots 12 & 13. These plots have direct access from the main road, which allows quick and safe access to the plant by waste removal trucks. The wastewater treatment system will reuse the 80% of this water for irrigation. Additionally, it is planned to send the 20% of the effluent to infiltration well.

Boardwalk:

A weave of boardwalks ("eco walks") will be installed throughout the property. The boardwalk will be wheelchair accessible and will be approximately 2.0 m wide (at the furthest edge to accommodate railings), approximately 2,163 metres long with two (2) 3m x 3m viewing station areas for guest educational purposes and birdwatching. It is anticipated that it will be approximately 1 – 1.5 m above ground level or the highest anticipated water level. It will be constructed of hard wood and placed on wooden piles. It will be constructed by using manual labour and no heavy equipment will be used.

Beach Works:

There will be beach works which will include the creation of groynes, jetty, submerged breakwaters, revetments, a jetty, some removal of beach rock, sand nourishment and the creation of a flushing channel. It is anticipated that approximately 3 submerged breakwaters, a jetty, 7 groynes, 3 revetment areas and 4 areas to be dredged. The estimated amount of dredge spoils to be generated is approximately 6,000 m^3. Suitable dredged material will be used as fill material on site where needed. Dredged material will be placed in a bermed holding area for dewatering after the fines have settled and then the suitable material used as fill on site while the remaining excess material (approximately 200 m^3) will be transferred to trucks and disposed of at an approved disposal site. Sand for beach works will either be imported from the Bahamas or manufactured sand used.

Scheduling:

The construction of the first phase is anticipated to take 18 – 24 months after which there will be a 1-year break and the construction of the second phase will commence with that phase anticipated to take an additional 18 – 24 months.

Employment:

The work force for the construction site will at peak time be approximately 1,500 trade men and labourers and should range from 700 -1500 during construction. This should create approximately 2,660 - 5,700 indirect and induced jobs during construction. To the extent practicable, Princess Hotels and Resorts will utilise local skills and labour for construction and operation of the hotel. Once fully operational (Phase I and II), Princess Hotels and Resorts expects to employ approximately 2,852 persons (Phase I – 1,417 pers. and Phase II – 1,435 pers.). The expected staffing for the operational phase of approximately 2,582 persons should result in approximately 4,763 indirect and 1,797 induced jobs.

Eco-Resort

The International Ecotourism Society (TIES) defines Eco-tourism as "Responsible travel to natural areas that conserves the environment and improves the well-being of local people". TIES outlines six basic principles for eco-tourism activities;

- Minimize impact.
- Build environmental and cultural awareness and respect.
- Provide positive experiences for both visitors and hosts.
- Provide direct financial benefits for conservation.

- Provide financial benefits and empowerment for local people.
- Raise sensitivity to host countries' political, environmental, and social climate.

The proposed project aims to create a responsible management plan focused on creating a healthy built environment based on ecological and resource-efficient principles. The hotel will utilize energy and resource efficiency such as low flow showers, taps and toilets; LED lights and solar panels; recycled water irrigation system and implementation of an Ecological management and Enhancement Plan. This will include the creation of bird sanctuary, specifically protecting the endangered whistling ducks and other waterfowl in the area, mangrove rehabilitation and enchantment plan, a sea turtle project, reef rehabilitation and fish sanctuary all the be development and maintained in conjunction with locals, stakeholders, NGO's and the hotel. These features will be an essential part of the hotels guest activities and education.

Description of the Environment

The proposed project area falls within the several categories of management and protection; The Negril Environmental Protection Area (Negril EPA), Negril Marine Park (NMP) and the Western section of the site on the boundary of the Environmental Replenishment Zone (Negril ERZ) and the Green Island Fish Sanctuary.

The beaches nearby and along the proposed project area were historically known for nesting and foraging turtles and manatees while the wetland areas are known for crocodiles, whistling ducks, and game birds associated with the significant black mangrove forest and wetland area. Other endemic flora and fauna species have been outlined above in previous studies and anecdotal information.

The seagrass along the nearshore of the proposed project area range from dense, *Thalassia* dominated beds to extremely sparse areas and areas dominated by macro algae. All three species of seagrass were found in the proposed project; *Thalassia testudinum, Syringodium filiforme*, and *Halodule wrightii*. The seagrass bed community is not uniformed, some areas appearing sparse with a short, discoloured blades or areas that lacked typical species such as hard coral species, invertebrates and fish. Some beds were dense with very long blades, epiphytes and macrofauna.

The proposed project area is associated with an extensive reef system, including a raised, fringing reef along Negro Bay, varying shallow pavement areas with patch reefs and Buttress with a varying relief, spur and groove formation.

The wetland and mangrove community is currently a healthy, mature and ecologically functional wetland system. The observed ecology of the area supports the expected services of a medium to large mangrove forest

A list of some ecological services of mangroves, specifically those observed at the proposed project site, are as follows:

- Bird Habitat (breeding)

- Bird feeding ground
- Crustacean, insect and reptile Habitat
- Water retention
- Nutrient Filtration
- Sediment trapping
- Prevention of saltwater intrusion
- Human food source
- Provision of wood for fuel, construction and fishing
- Cultural uses (crab hunting and bird shooting)
- Coastal Buffer Zone (storm and erosion control)
- Nursery for juvenile marine organisms
- Carbon sequestering

Terrestrial species observed during the study include, a total of 35 species of terrestrial birds, 9 of which were endemic, 4 endemic subspecies, 8 migrants and 14 resident species. A total of 18 wetland birds, 16 of which were resident species and 2 which were migrant species. Including *Dendrocygna arborea* (West Indian Whistling Duck).

Only 2 amphibian species were observed; the introduced *Eleutherodactylus johnstonei* and the endemic *Eleutherodactylus cundalli*. Four (4) species of *Anolis* were seen while crocodiles are known to utilize the area. Over 51 species of insects were identified, including 25 species of butterflies.

POTENTIAL IMPACTS AND RECOMMENDED MITIGATION

Site Preparation and Construction Phase – Hotel and Beach Works

CATEGORY		POTENTIAL IMPACT	RECOMMENDED MITIGATION
Physical	Drainage and Runoff	Sedimentation and pollution of mangrove forest	A construction drainage plan will be developed to control the discharge of oil/lubricants, sediment and debris into the mangrove areas, consisting of: • Site grading • Sediment retention basins and other measures for minimizing the transport of sediment • Grease traps and/or oil water separators.
	Water Quality	Sedimentation of marine environment from beach works	• The project site should utilize sediment control measures such as turbidity barriers/silt screens and should be erected around the entire work area to prevent the dispersion of sediments and contaminants throughout the water column. • A central area will be designated for the storage of chemicals. This area should be lined in order to prevent the leakage of chemicals into the sediment. • Fine grained materials (sand, marl, etc.) will be stockpiled away from drainage channels and low berms will be placed around the piles which themselves will be covered with tarpaulin to prevent them from being eroded and washed away. Silt fences may also be utilized to prevent siltation. • All boulders used for coastal structures should be washed at a designated area at the quarry before being transported to the site. The boulders should be stored in a designated area away from any fines and mud before being placed in the marine environment. • Raw materials that generate dust should be covered or wetted frequently to prevent them from becoming air or waterborne. • Raw material and equipment should be stored on impermeable hard stands surrounded by berms to contain any accidental surface runoff. • Bulk storage of fuels and oils should be in clearly marked containers (tanks/drums etc.) indicating the type and quantity being stored. In addition, these containers should be surrounded by bunds to contain the volume being stored in case of accidental spillage. • Refuelling of boats should only be done at anchor out at sea if the sea conditions are calm, otherwise, all refuelling should be done when docked at land. Appropriate refuelling equipment (such as funnels) and techniques should always be used. • Appropriate minor spill response equipment (for containment and clean- up) will kept on site, including oil absorbent pads and disposal bags. • In terms of transporting equipment, the paths of the planned roadways will be used, rather than creating temporary pathways just for equipment access. • Raw materials such as marl and sand should be adequately covered within the trucks to prevent any escaping into the air and along the roadway. • Vehicle refuelling facilities must be situated on impermeable surfaces served by an oil trap, run-off collection system. Sediment basins and oil water separators should be constructed to intercept storm water before it is discharged.
		Pollution of marine environment from fuel, lubricants, hazardous substances from construction equipment	
	Dredging	Increased suspended solids, turbidity, BOD and the reduction in light penetration and dissolved oxygen in the water column	• Turbidity barriers/silt screens are recommended to be used around all dredging activities. These should be placed so as to reduce/contain the resultant sediment plume during these activities. Dredging activities should only occur when these barriers are fully operational, that is; placed correctly; in calm to moderate sea conditions; and without damage. These barriers are particularly important when operations occur near or may influence sensitive ecosystems and species such as coral reefs and seagrass beds and or filter feeding organisms. The silt screens should encircle the areas and be deep enough to contain the plumes so that plumes will not travel in the direction of the prevailing currents. • Care should be taken to dredge only in approved dredge areas. Dredge areas and a buffer area should be demarcated to avoid accidental dredging in unauthorized areas. • Dredging operations should be continually monitored to ensure equipment and machinery are in good repair and regularly serviced to prevent oil leaks during regular operations.
		Suspension of heavy metals from the substrate	
		Affect sensitive coastal ecological habitats	

CATEGORY		POTENTIAL IMPACT	RECOMMENDED MITIGATION
			• Dredge spoils deposited on land will be placed in a bermed holding area for dewatering after the fines have settled and then the material transferred to trucks to be either disposed of or used on site if needed.
	Noise	Noise nuisance from construction equipment on surrounding residential and educational communities	• Use equipment that has low noise emissions as stated by the manufacturers. • Use equipment that is properly fitted with noise reduction devices such as mufflers. • Operate noise-generating equipment during regular working hours (e.g. 7 am – 7 pm) to reduce the potential of creating a noise nuisance during the night. • Construction workers operating equipment that generates noise should be equipped with noise protection. A guide is workers operating equipment generating noise of ≥ 80 dBA (decibels) continuously for 8 hours or more should use earmuffs. Workers experiencing prolonged noise levels 70 - 80 dBA should wear earplugs.
	Air Quality	Dust nuisance from transportation of raw material on surrounding residential and educational communities Fugitive dust effect on construction workers and residential communities	• Areas should be dampened every 4-6 hours or within reason to prevent a dust nuisance and on hotter days, this frequency should be increased. • Minimize cleared areas to those that are needed to be used. • Cover or wet construction materials such as marl to prevent a dust nuisance. • Where unavoidable, construction workers working in dusty areas should be provided and fitted with N95 respirators.
Biological	Mangrove Community	Loss of 4.128 hectares (10.18 acres) of mature mangrove forest and less robust mangrove forest	• Mangrove rehabilitation is proposed in select degraded areas. Approximately 8.68 acres of potential mitigation/compensation areas were found within the property boundary. • Parking and Industrial Areas alone require 6.57 acres of the 10.18 acres of mangrove forest to be cleared. Discussions will be had with the Hanover Municipal Corporation to request a reduction in the number of parking spaces needed. • Use of Solar power generation for an overall net positive reduction in CO_2 emissions. Boardwalk Related Mitigation: • The boardwalk should be constructed in stages (finishing one section and moving on in a continuous buildout plan) and without the use of heavy equipment to reduce the potential impact area. • Construction should not be undertaken during periods of heavy rain/ rainy season. • Construction materials should be natural and blend in with the forest to reduce the visual impact of fauna. The materials should be strong, rust resistant and should not be treated with chemicals which may leach into the environment. • The use of hazardous or toxic substances should not be undertaken in or near waterways. • Older and larger mangrove trees should be avoided
		Natural closing of drainage pathways affecting hydrology within mangrove forest	The tidal creek (adjacent to Transect 9) should be maintained with little or no disturbance. It may be beneficial to erect a concrete structure in this location to prevent natural mangrove forest growth which may enclose this vital exchange point.
		Urban sprawl and informal settling in neighbouring mangrove forests	Steps must be taken by the Contractor and respective agencies to not only conserve the wetlands at the proposed impact site, but also prevent further informal settlement sprawl in other neighbouring wetlands.
	Terrestrial Fauna	Displacement of the "IUCN Vulnerable" West Indian Whistling Ducks on site	• Efforts should be made to retain some areas of the wetland habitat for the ducks to continue to occupy. This may include the development of bird sanctuary. • Boardwalk viewing areas should also be created for guest educational purposes and bird watching.
		Displacement of the "IUCN Near Threatened" Endemic Rock Frog on site	Efforts should be made to preserve some of the mangrove trees and associated bromeliads (primary habitat for the endemic rock frog (*Eleutherodactylus cundalli*) on the property.
		Possible presence of crocodiles in the area and interactions with construction workers	The site should be fenced, and signage should be placed around the site informing and educating construction crews about the possibility of crocodiles and what to do if one is observed. Any sighting of a crocodile in the area at any stage of the project should be reported to the National Environment and Planning Agency (NEPA).
	Coral and sessile fauna	Species Loss	Coral Relocation, Fish Havens and Electrified Artificial Reef
		Smothering of sensitive nearby coral and reduced light from sedimentation Impaired filter feeding and photosynthesis from prolonged sedimentation	• During construction, the project site should include sediment control measures such as turbidity barriers/silt screens and should be erected around the entire work area to prevent the dispersion of sediments and contaminants throughout the water column. These should be placed so as to reduce/contain the resultant sediment plume during the activities. Construction activities should only continue when these barriers are fully operational, that is; placed correctly; calm to
	Seagrass	Species loss and habitat fragmentation Temporary shading by floating structures/vessels	

CATEGORY		POTENTIAL IMPACT	RECOMMENDED MITIGATION
		Smothering of seagrass blades and epiphytes from sedimentation Reduced light penetration and resulting decrease in photosynthesis Mechanical abrasion from moorings and anchors	moderate sea conditions; without damage. These barriers are particularly important when operations occur near or may influence sensitive ecosystems and species such as coral reefs and seagrass beds and or filter feeding organisms and fish. • Weekly monitoring of water quality parameters such as temperature, salinity, pH, Dissolved Oxygen, light irradiance and turbidity in and around the project area, for the first 3 months during construction. Monitoring can be conducted fortnightly thereafter. • Conduct sediment dispersal calculation rates on coral reefs and seagrass beds within 200 meters of the proposed villas and at control stations, on a monthly basis, for comparison to background levels. Pre-construction sedimentation rates should therefore also be conducted and used as a baseline for comparison. • All activities should be limited to the minimal working area, and as such reducing the extent of the footprint. No activities and or placement of anchors or materials should be done placed outside the approved area. • Relocation of sensitive species should be done if; they are suitable for relocation (that is suitable substrate, health and over all viability), those species fall within the potential impact area; and if mobile invertebrates are in or around the potential impact area. Sensitive organisms and systems in and outside the impact area include; hard and soft corals, sponges, seagrass and mobile invertebrates such as urchins, sea cucumbers, starfish and conch. Detailed Seagrass and Coral Removal and Relocation Plans, as well as a Post-Relocation Monitoring Plan, must be prepared for approval by NEPA. • Alternative mitigations should be proposed when relocation is unlikely to be successful. • Where possible, as little of the natural environment should be relocated or removed. Habitat fragmentation and species displacement should be temporary, with the placement of silt screens, construction materials and equipment as well as general human activity in the area. • Structures placed on the seafloor may cause habitat fragmentation and displace some species, however they may also serve to add ecological volume, providing substrate for organisms to settle and colonize and eventually may serve some ecosystem functions. • Any temporary floating structures and /or vessels should be placed in areas with less sensitive species where possible. Floating structures anchored or moored over seagrass beds or coral colonies should not be left for prolonged time periods as the resulting shading effects may cause deterioration in overall health of the seagrass bed and coral colonies
	Fish and Invertebrates	Temporary loss/displacement of fish habitat Clogging of gills from excess, prolonged sedimentation Reduction in food supply as a result of decreased water quality and change in plankton composition	• During construction, the project site should include sediment control measures such as turbidity barriers/silt screens and should be erected around the entire work area to prevent the dispersion of sediments and contaminants throughout the water column. These should be placed so as to reduce/contain the resultant sediment plume during the activities. Construction activities should only continue when these barriers are fully operational, that is; placed correctly; calm to moderate sea conditions; without damage. These barriers are particularly important when operations occur near or may influence sensitive ecosystems and species such as coral reefs and seagrass beds and or filter feeding organisms and fish. • Weekly monitoring of water quality parameters such as temperature, salinity, pH, Dissolved Oxygen, light irradiance, turbidity and Total Suspended Solids (TSS) in and around the project area should be conducted during construction. • Conduct sediment dispersal calculation rates on coral reefs and seagrass beds within 200 meters of the proposed villas and at control stations, on a monthly basis, for comparison to background levels. Pre-construction sedimentation rates should therefore also be conducted and used as a baseline for comparison. • All activities should be limited to the minimal working area, and as such reducing the extent of the footprint. No activities and or placement of anchors or materials should be done placed outside the approved area.
	Sea Turtles	Temporary disturbance/displacement from construction activity, lights and noise	• Attempts should be made to schedule the majority of the beach works (breakwaters, groynes, nourishment etc.) outside of turtle nesting season (May – October). • All staff and workers should be sensitized to the all sensitive ecosystems and species in the area, in particular turtles. The site should be inspected daily for any signs of turtle activity. If a nest is suspected or found, all activity nearby should stop until an expert can determine if there is a nest and how to relocate the eggs. • The stakeholders, proponents and the NEPA should develop clear lines of reporting and communication in the event that action needs to be taken. • Silt screens should be used to prevent sedimentation but should be removed promptly along with any other construction debris and material upon completion.

CATEGORY		POTENTIAL IMPACT	RECOMMENDED MITIGATION
			• Night-time activities should be limited or avoided when possible. No lights should be pointed out to sea. This may confusion and disorientation of turtles or any other species that maybe affected by lunar activity. • Fixtures in direct line-of-sight from the beach should be shielded down-light only fixtures or recessed fixtures having low wattage "bug" type bulbs and non-reflective interior surfaces. • Fixtures mounted as low in elevation as possible through use of low-mounted wall fixtures, low bollards and ground level fixtures. • Floodlights, up-lights or spotlights for decorative and accent purposes that are directly visible from the beach or which indirectly or cumulatively illuminate the beach shall not be used. • For high intensity lighting applications such as providing security and similar applications shielded low-pressure sodium vapour lamps and fixtures shall be used
Human/Social	Employment	Creation of direct, indirect and induced jobs	No mitigation required
	Solid Waste	Increased generation of solid waste	• Skips and bins should be strategically placed within the campsite and construction site. • The skips and bins at the construction campsite should be adequately designed and covered to prevent access by vermin and minimise odour. • The skips and bins at both the construction campsite and construction site should be emptied regularly to prevent overfilling. • Disposal of the contents of the skips and bins should be done at an approved disposal site – Retirement Disposal Facility, St. James.
	Wastewater	Contamination of marine environment from accidental spillage of portable toilets	• Provision and maintenance of portable sanitary conveniences for the construction workers for control of sewage waste by a licenced contractor. A ratio of approximately 25 workers per chemical toilet should be used. • Showers should be provided for the workers. • Portable toilets should be located at a distance from the shoreline to avoid discharge into the marine environment in the event of accidental spillage.
	Vending and Hygiene	Illnesses resulting from improper food handling practices	• Provision of adequate supply of potable water. • The monitoring of the various 'cook shops" by public health authorities and the construction management team, to ensure proper hygiene is being followed. • The provision of areas to adequately wash hands and utensils.
		Negative visual effect on area	
	Transportation and Traffic	Traffic travelling along the through lanes to Negril and Lucea are not significantly affected during the construction phases	No mitigation required
		Vehicles entering and exiting the hotel property are expected to experience tolerable delays for short periods	
		Effect of overweight vehicles on road surface	In order to alleviate road damages, all the weight of trucks carrying construction materials must be determined by scale and overloading is strictly prohibited as per NWA weight limit requirements.
		General Traffic Management	• Construction traffic entering or leaving the site will be scheduled for off peak hours to minimize additional congestion at the intersections and/or disruptions in the regular traffic flow. • Construction next to the highway will be scheduled for off peak hours and adequate traffic management procedures/methods will be put in place. • Adequate covering up of the works to minimize danger to passing traffic. • Erection of signs ahead of the works warning motorists of the construction ahead.
		Accident potential south of Access Road 1	Increased signage in the area to remind motorists to reduce their speed as they approach each intersection.
	Occupational Health and Safety	Potential for accidental injury of construction workers	• The provision of lifelines, personal safety nets or safety belts and scaffolding for the construction workers (if necessary) • Ensuring that workers wear personal protective equipment (hard hats, reflective vests, safety shoes, eye protection etc.) • Where unavoidable, construction workers working in dusty areas should be provided and fitted with N95 respirators. • Areas should be dampened every 4-6 hours or within reason to prevent a dust nuisance and on hotter days, this frequency should be increased.
		Fugitive Dust effect on health of construction workers	

CATEGORY		POTENTIAL IMPACT	RECOMMENDED MITIGATION

			• There should be onsite first aid kits and arrangement for a local nurse and/or doctor to be on call for the construction site.
			• Make prior arrangements with local health care facilities such as health centres or the Noel Holmes Hospital in Lucea to accommodate any eventualities
			• Make prior arrangements with the Lucea Fire Station and Green Island Police Station to accommodate any eventualities.
			• Material Safety Data Sheets (MSDS) should be stored onsite.
			• A lead person should be identified and appointed to be responsible for emergencies occurring on the site. This person should be clearly identified to the construction workers.
			• Trench Excavation
			  ○ A trench 1.2m or more in depth must have a means of egress (ladders/ stairways/ramps) and should be located at 8m intervals.
			  ○ Excavated materials must be stored 0.6m or more from the open trench (not to be measured from the crown of the spoil).
			  ○ Spoil should be placed so that the channels rainwater and other runoff water away from the excavation.
			  ○ Take precautions regarding Tension Cracks
			    ▪ Tension cracks usually form at a horizontal distance of 0.5 to 0.75 times the depth of the trench.
			    ▪ Sliding or sloughing may occur as a result of tension cracks

	Aesthetics	Decreased aesthetic appeal of construction site activities	Good housekeeping activities and adherence to other mitigative measures.
		Trucks leaving the construction site have the potential to deposit marl and mud onto the main road, making the main road aesthetically unappealing.	• An area of gravel should be placed on site (just before exiting onto the main road) to help remove mud/marl from truck wheels. • A wheel wash area on site (just before exiting onto the main road) should be implemented to rid wheels of as much mud/marl as possible
	Historical Artefacts	No historical, archaeological features were uncovered. No artefacts were recovered.	No mitigation required

Operational Phase – Hotel and Beach Works

CATEGORY		POTENTIAL IMPACT	RECOMMENDED MITIGATION
Physical	Drainage and Hydrology	Increased flood levels within mangrove forest Flooding of adjacent communities Runoff to drain freely into mangrove forest via ten outfall points	• Enhancement to the mangrove system is proposed by introducing several culvert openings throughout the existing road network within the mangrove. This would promote more free movement of water through the entire mangrove forest, which will improve the storage capacity and provide water to areas currently deprived of water. • Several ponds are proposed within the barren elevated areas in the midst of the mangrove to alleviate any flooding impact on adjacent communities. • The proposed drainage concept will allow rainfall runoff to drain freely into the mangrove via ten outfall points. All the outfall points were set at an elevation higher than the projected flood elevation for the 1 in 50-yr storm frequency, with consideration for climate change.
	Currents	Flushing channel does not significantly change the currents along the project site	No mitigation required
		Flushing channel helps to draw out any pollutant and reduce the concentration with Negro Bay	No mitigation required
	Sediment Transport	Sediment transport regime remained unchanged	No mitigation required
		No significant impact to downdrift shorelines	No mitigation required
Biological	Vegetation	Introduction of invasive alien plant species via landscaping activities can result in their proliferation.	Ensure that plants used for landscaping are native/local species. Exotic/unknown plant species should not be used in landscaping.
	Reef Community	Hard structures (groynes, breakwaters, jetty) will provide of ecological volume and substrate for colonization and recruitment	No mitigation required
	Fish	Hard structures (groynes, breakwaters, jetty) will act as Fish Aggregation Devices (FADs)	No mitigation required
	Sea Turtles	Alteration of food source from seagrass bed modification Hard structures act as deterrent from going ashore to nest Noise and lighting act as deterrent from going ashore to nest	• Artificial lighting should not be placed on the beach. If lights have to be used, turtle-friendly lighting and light positioning (if any) should be used. • Hotel operators should also educate their guests on sea turtle conservation and the correct actions to take if a sea turtle is observed nesting on the beach • Development of a Sea Turtle Monitoring programme which would include tagging and hatchling release.
Natural Hazards	Swell Wave Climate	Wave climate unchanged by breakwaters located at Hotel 1	No mitigation required
		Wave climate reduced by breakwaters located at Hotel 4	No mitigation required
		Swimming areas created at Hotels 2 and 3 have reduced wave energy	No mitigation required
	Hurricane Waves and Storm Surge	Storm surge reduced by breakwaters located at Hotel 4	No mitigation required
		Flooding of hotel blocks by storm surge	Adhere to recommended floor level heights
	Climate Change	Flooding from increased rainfall intensity	Structures and buildings were designed for higher than standard return events
		Siltation of drainage systems and coastal areas	• Drainage plans are fortified with silt traps to reduce the siltation impact to the coastal areas. • Flushing channel to increase the circulation of the area overtime
		Sea level rise and resulting increased storm surge	The floor levels for the property were set to be above the 100-year storm surge events.
		Structural Fatigue from increased storm surge	All rock structures were also designed to withstand stronger waves that come from more intensive storms.
Human/Social	Employment	Creation of direct, indirect and induced jobs	No mitigation required
	Water supply and consumption	Burdening of the water supply in the area in the event of drought conditions.	It is recommended that various storage and conversation measures be put in place at the hotel such as: • Low flow fixtures • Dual flush toilets • Faucets fitted with aerators • Electronic spigots and flush valves Other operational strategies for reduction of water consumption include: • Do not leave the tap running while cleaning, using buckets for holding water instead • Make sure that all faucets do not leak and are in good repair • Report immediately any leaking or dripping faucet or toilet • Give guests the option of changing linen and towels every two or three days

CATEGORY		POTENTIAL IMPACT	RECOMMENDED MITIGATION
			• Use only the minimum required amount of detergent in the laundry • Reuse rinse-water in the first cycle of washing of the next load • Separate the laundry's hot-water system from the guest room hotel-water system if possible • Hotel guests can be given politely written cards as to how to conserve water in their bathrooms, for example to, shut off water during tooth brushing, shaving, and other unnecessary period • Keep utility bills to track the consumption of water • Purchase and use water-saving equipment always • Establish an effective employee training program about water conservation • Wash food products in buckets, bowls or containers • Use dishwasher with sufficient loads • Make regular inspections of dishwasher pumps for water leakage • Do not use water to defrost or thaw frozen food products, defrost in refrigerator • Recover waste pool water for reuse • Use wastewater effluent for irrigation
	Tourism	Improvement of the tourism product of the country	No mitigation required

	Emergency Response	Workers and guests may become ill or have accidents. In addition, disasters such as earthquakes, floods, storm surge and fires are real possibilities.	• Have first aid kits located in various sections of the hotel.
			• Design and implement an emergency response plan.
			• Staff should be trained in CPR and basic first aid.
			• Arrange for mutual assistance and make prior arrangements with:
			    ○ Health care facilities, Noel Holmes Hospital and associated doctors and nurses to accommodate any eventualities.
			    ○ Arrange with other health practitioners to be on call or have an in-house physician/nurse.
			    ○ Lucea Fire Station (additional firefighting units and a fire boat)
			    ○ Green Island Police Station (police personnel in addition to the Tourism Courtesy Corp Officers)

	Solid Waste	Increased solid waste generation	• Provision of solid waste storage bins and skips. • Provision of adequately designed bins and skips to prevent access by vermin. • Monitor beach garbage. • Contracting a private contractor to collect solid waste in a timely fashion to prevent a build-up. • Ensure that the solid waste collected is disposed in an approved disposal site - Retirement Disposal Facility, St. James.
	Transportation and Traffic	Traffic travelling along the main road are not significantly affected	No mitigation required
		Vehicles entering and exiting the hotel property are expected to experience tolerable delays for short periods	The assessment revealed that it is not necessary for either intersection to be signalized as the volume of traffic does not warrant the installation. However, the implementation of acceleration and deceleration lanes may decrease the frequency of accidents in the area.
		A Traffic light will increase the delay for vehicles, thus decreasing the Level of Service	

Site Preparation and Construction Phase – Overwater Searooms

CATEGORY		POTENTIAL IMPACT	RECOMMENDED MITIGATION
Physical	Water Quality	Increased TSS/turbidity in water during construction activities (piling installation etc.) Increased TSS/turbidity in water from temporary boulder construction pad	• During construction, the project site should include sediment control measures such as turbidity barriers/silt screens and should be erected around the entire work area to prevent the dispersion of sediments and contaminants throughout the water column. • Weekly monitoring of water quality parameters such as temperature, salinity, pH, Dissolved Oxygen, light irradiance, turbidity and Total Suspended Solids (TSS) in and around the project area should be conducted during construction for the first 3 months. Monitoring can be conducted fortnightly thereafter. • Conduct sediment dispersal calculation rates on coral reefs and seagrass beds within 200 meters of the proposed overwater villas and at control stations, on a monthly basis, for comparison to background levels and pre-construction sedimentation rates.
		Stagnation of water behind the boulder construction pad	Culverts will be constructed through the construction pad to allow for exchange of water.
	Noise	Noise impact on surrounding residential and educational communities and construction workers	• Use equipment that has low noise emissions as stated by the manufacturers. • Use equipment that is properly fitted with noise reduction devices such as mufflers. • Operate noise-generating equipment during regular working hours (e.g. 7 am – 7 pm) to reduce the potential of creating a noise nuisance during the night. • Construction workers operating equipment that generates noise should be equipped with noise protection. A guide is workers operating equipment generating noise of ≥ 80 dBA (decibels) continuously for 8 hours or more should use earmuffs. Workers experiencing prolonged noise levels 70 - 80 dBA should wear earplugs.
Biological	Seagrass	Temporary shading by floating structures/vessels Smothering of seagrass blades and epiphytes from sedimentation Reduced light penetration and resulting decrease in photosynthesis Mechanical abrasion from moorings and anchors	• During construction, the project site should include sediment control measures such as turbidity barriers/silt screens and should be erected around the entire work area to prevent the dispersion of sediments and contaminants throughout the water column. These should be placed so as to reduce/contain the resultant sediment plume during the activities. Construction activities should only continue when these barriers are fully operational, that is; placed correctly; calm to moderate sea conditions; without damage. These barriers are particularly important when operations occur near or may influence sensitive ecosystems and species such as coral reefs and seagrass beds and or filter feeding organisms and fish. • Weekly monitoring of water quality parameters such as temperature, salinity, pH, Dissolved Oxygen, light irradiance and turbidity in and around the project area, for the first 3 months during construction. Monitoring can be conducted fortnightly thereafter. • Conduct sediment dispersal calculation rates on coral reefs and seagrass beds within 200 meters of the proposed villas and at control stations, on a monthly basis, for comparison to background levels. Pre-construction sedimentation rates should therefore also be conducted and used as a baseline for comparison. • All activities should be limited to the minimal working area, and as such reducing the extent of the footprint. No activities and or placement of anchors or materials should be done placed outside the approved area. • Relocation of sensitive species should be done if; they are suitable for relocation (that is suitable substrate, health and over all viability), those species fall within the potential impact area; and if mobile invertebrates are in or around the potential impact area. Sensitive organisms and systems in and outside the impact area include; hard and soft corals, sponges, seagrass and mobile invertebrates such as urchins, sea cucumbers, starfish and conch. Detailed Seagrass and Coral Removal and Relocation Plans, as well as a Post-Relocation Monitoring Plan, must be prepared for approval by NEPA. • Alternative mitigations should be proposed when relocation is unlikely to be successful. • Where possible, as little of the natural environment should be relocated or removed. Habitat fragmentation and species displacement should be temporary, with the placement of silt screens, construction materials and equipment as well as general human activity in the area. • Structures placed on the seafloor may cause habitat fragmentation and displace some species, however they may also serve to add ecological volume, providing substrate for organisms to settle and colonize and eventually may serve some ecosystem functions.
	Coral and sessile fauna	Smothering of sensitive nearby coral including *Acropora palmata* and reduced light from sedimentation Impaired filter feeding and photosynthesis from prolonged sedimentation	

CATEGORY		POTENTIAL IMPACT	RECOMMENDED MITIGATION
			• Any temporary floating structures and /or vessels should be placed in areas with less sensitive species where possible. Floating structures anchored or moored over seagrass beds or coral colonies should not be left for prolonged time periods as the resulting shading effects may cause deterioration in overall health of the seagrass bed and coral colonies
	Fish	Temporary loss/displacement of fish habitat Clogging of gills from excess, prolonged sedimentation Reduction in food supply as a result of decreased water quality and change in plankton composition	• During construction, the project site should include sediment control measures such as turbidity barriers/silt screens and should be erected around the entire work area to prevent the dispersion of sediments and contaminants throughout the water column. These should be placed so as to reduce/contain the resultant sediment plume during the activities. Construction activities should only continue when these barriers are fully operational, that is; placed correctly; calm to moderate sea conditions; without damage. These barriers are particularly important when operations occur near or may influence sensitive ecosystems and species such as coral reefs and seagrass beds and or filter feeding organisms and fish. • Weekly monitoring of water quality parameters such as temperature, salinity, pH, Dissolved Oxygen, light irradiance, turbidity and Total Suspended Solids (TSS) in and around the project area should be conducted during construction for the first 3 months, then fortnightly thereafter • Conduct sediment dispersal calculation rates on coral reefs and seagrass beds within 200 meters of the proposed villas and at control stations, on a monthly basis, for comparison to background levels. Pre-construction sedimentation rates should therefore also be conducted and used as a baseline for comparison. • All activities should be limited to the minimal working area, and as such reducing the extent of the footprint. No activities and or placement of anchors or materials should be done placed outside the approved area.
	Sea Turtles	Temporary disturbance/displacement from construction activity, lights and noise	• Attempts should be made to schedule the majority of the construction period outside of turtle nesting season (May – October). • All staff and workers should be sensitized to the all sensitive ecosystems and species in the area, in particular turtles. The site should be inspected daily for any signs of turtle activity. If a nest is suspected or found, all activity nearby should stop until an expert can determine if there is a nest and how to relocate the eggs. • The stakeholders, proponents and the NEPA should develop clear lines of reporting and communication in the event that action needs to be taken. • Silt screens should be used to prevent sedimentation but should be removed promptly along with any other construction debris and material upon completion. • Night-time activities should be limited or avoided when possible. No lights should be pointed out to sea confusion and disorientation of turtles or any other species that maybe affected by lunar activity. • Fixtures in direct line-of-sight from the beach should be shielded down-light only fixtures or recessed fixtures having low wattage "bug" type bulbs and non-reflective interior surfaces. • Fixtures mounted as low in elevation as possible through use of low-mounted wall fixtures, low bollards and ground level fixtures. • Floodlights, up-lights or spotlights for decorative and accent purposes that are directly visible from the beach or which indirectly or cumulatively illuminate the beach shall not be used. • For high intensity lighting applications such as providing security and similar applications shielded low-pressure sodium vapour lamps and fixtures shall be used.
Human/Social	Maritime Traffic	Fishing and other maritime activities affected by construction process Accident potential due to presence of maritime vessels, structures and equipment at sea	The use of highly visible marker buoys demarcating an exclusion zone should be used to keep out other marine traffic and fishers from the work area to prevent potential accidents
	Health and Safety	Occupational Health and safety of workers (accident potential)	• A lead person should be identified and appointed to be responsible for emergencies occurring on the site. This person should be clearly identified to the construction workers. • At least two (2) certified lifeguards should be hired and be on site during work hours in the event of potential accidental drowning. • The construction management team should have onsite first aid kits and make arrangements for the nurse and doctor at Noel Holmes Hospital to be on call for the construction site. Prior arrangements should be made with health care facilities/clinics to accommodate any eventualities. • Make prior arrangements with the Lucea Fire Station and Green Island Police Station to accommodate any eventualities.

CATEGORY		POTENTIAL IMPACT	RECOMMENDED MITIGATION
			• Material Safety Data Sheets (MSDS) should be stored onsite
	Aesthetics	Decreased aesthetic appeal	Good housekeeping activities and adherence to other mitigative measures especially with regard to potential marine water quality contamination.

Operational Phase – Overwater Searooms

<table>
<tr><th colspan="2">CATEGORY</th><th>POTENTIAL IMPACT</th><th>RECOMMENDED MITIGATION</th></tr>
<tr><td rowspan="5">Biological</td><td>Reef and Seagrass Communities</td><td>Searoom pilings provide ecological volume for coral colonization and recruitment</td><td>No mitigation required</td></tr>
<tr><td>Fish</td><td>Searoom pilings and shaded areas will act as Fish Aggregation Devices (FADs)</td><td>No mitigation required</td></tr>
<tr><td rowspan="3">Sea Turtles</td><td>Alteration of food source from seagrass bed modification</td><td rowspan="3">• Turtle-friendly lighting and light positioning (if any) should also be placed on the searooms
• Hotel operators should also educate their guests on sea turtle conservation and the correct actions to take if a sea turtle is observed nesting on the beach
• Development of a Sea Turtle Monitoring programme which would include tagging and hatchling release.</td></tr>
<tr><td>Searoom structures/pilings act as deterrent from going ashore to nest</td></tr>
<tr><td>Noise and lighting act as deterrent from going ashore to nest</td></tr>
<tr><td rowspan="3">Natural Hazards</td><td>Climate Change</td><td>Design calculations for the proposed concepts included projections for sea level rise to the year 2100</td><td>No mitigation required</td></tr>
<tr><td>Storm Surge</td><td>Potential Damage of searooms by storm surge</td><td>Adhere to recommended floor level heights</td></tr>
<tr><td>Hurricane Wave Climate</td><td>Natural Reef system aids in reduction of wave energy</td><td>No mitigation required</td></tr>
<tr><td rowspan="5">Human/Social</td><td rowspan="2">Maritime Traffic</td><td>Maritime activities affected by presence of searooms</td><td rowspan="2">• After construction is completed, permanent highly visible marker buoys should be placed at strategic points around the overwater rooms.
• Turtle-friendly lighting and light positioning should also be placed on the searooms so that they are visible to marine vessels at nighttime.</td></tr>
<tr><td>Accident potential due to possibility of collision with searoom structures</td></tr>
<tr><td>Aesthetics</td><td>Improvement of the aesthetic appeal of the hotel</td><td>No mitigation required</td></tr>
<tr><td>Emergency Response</td><td>Workers and guests may become ill or have accidents. In addition, disasters such as storm surge and fires are real possibilities.</td><td>• Have first aid kits located in various sections of the hotel.
• Design and implement an emergency response plan.
• Staff should be trained in CPR and basic first aid.
• Arrange mutual assistance and make prior arrangements with:
○ Health care facilities, Noel Holmes Hospital and associated doctors and nurses to accommodate any eventualities.
○ Arrange with other health practitioners to be on call or have an in-house physician/nurse.
○ Lucea Fire Station (fire boat)
○ Green Island Police Station (Marine police to conduct patrols in the vicinity of the overwater searooms). This may also be conducted by contracted private security.</td></tr>
<tr><td>Tourism</td><td>Improvement of the tourism product of both the hotel and the country</td><td>No mitigation required</td></tr>
</table>

ALTERNATIVES

The following project alternatives were identified:

- Alternative 1 - The "No-Action" Alternative
- Alternative 2 - The Project as Proposed in the EIA
- Alternative 3 – The Project as Proposed in the EIA, but without the sea rooms
- Alternative 4 – The Project as Proposed in the EIA, but without Hotel Block 3
- Alternative 5 - The Project as Proposed in the EIA, but with a longer boardwalk

The Preferred Alternative is **Alternative 2** - The Project as Proposed in the EIA.

ENVIRONMENTAL MANAGEMENT AND MONITORING PLANS

As part of the Environmental Management System (EMS), it is recommended that several parameters be monitored before, during and after the project implementation to record any negative construction impacts and to propose corrective or mitigation measures. The suggested parameters include but not limited to the following:

1) Water Quality to include but not be limited to:
    a. Nitrates
    b. Phosphates
    c. BOD
    d. Fats, oil and grease
    e. pH
    f. TSS
    g. Turbidity
    h. TDS
    i. Faecal Coliform
2) Noise
3) Coral and Fisheries
4) Seagrass
5) Traffic
6) Maritime Operations
7) Solid Waste Generation and Disposal
8) Sewage Generation and Disposal
9) Equipment Maintenance
10) Health and Safety

Other specific Management/Monitoring Plans applicable to this project include:

Mangrove Management Plan: This will include a combination of existing and replanted mangrove survey/monitoring exercises and water quality monitoring before, during and after construction. The activities will be conducted by qualified and trained mangrove ecologists.

Coral Management Plan: This will include a combination of coral monitoring exercises (using photo-transects and roving surveys) water quality monitoring and sediment dispersal monitoring, before, during and after construction. The activities will be conducted by qualified and trained marine scientists and SCUBA divers.

Seagrass Management Plan: This will include a combination of seagrass survey/monitoring exercises and water quality monitoring before, during and after construction. The activities will be conducted by qualified and trained marine scientists and SCUBA divers.

CONCLUSION AND RECOMMENDATIONS

This proposed development is slated to increase the room offerings of the island, thereby creating jobs and economic benefits, growing the tourist clientele and in the process enhance and diversify the Jamaican tourism product.

On the contrary, the degradation, loss and adverse effects of natural habitats as well as impacts on the noise climate, air quality and solid waste facilities, are some of the potential negative impacts of the project. These concerns are highlighted through the stakeholder involvement and public interviews conducted for the purposes of this EIA.

The implementation of the recommended mitigation measures detailed in this EIA, as well as the various environmental management and monitoring programmes, will assist in reducing these negative impacts.

2.0 INTRODUCTION

2.1 PROJECT CONTEXT AND RELEVANCE

Princess Hotels and Resorts Limited has acquired approximately 73 hectares (180 acres) of land in Green Island, Hanover and is desirous of constructing a 2037-room eco-resort on approximately 34 hectares (≈ 84 acres) of it. This will consist of a combination of four (4) separate hotel blocks and fourteen (14) overwater searooms.

Destination Jamaica continues to offer a diverse product of very high quality to its visitors, through its expansive and inclusive nature. The wide range of hotels, attractions and activities has allowed Jamaica to deliver on visitor expectations, unequalled visitor experiences and provide value for money.

This development fits into the Governments' drive of increasing tourism arrivals, diversifying the locations of tourism infrastructure from the traditional areas of Negril, Ocho Rios, Montego Bay, Port Antonio and Kingston and increasing the tourism offerings. With the Governments' drive of increasing tourism arrivals there's a concomitant increase in hotel rooms to accommodate the expected stop over visitors.

The proposed project complies with Vision 2030; the National Vision Statement - **"Jamaica, the place of choice to live, work, raise families, and do business**". A part of the vision is that; we are the premier destination to visit and do business.

This proposed development will increase the room offerings of the island, thereby growing the clientele and in the process enhance the Jamaican tourism product.

2.1.1 Project-Specific Progress

The Permit Application for the proposed project was submitted on 17 September 2019. It was decided that an Environmental Impact Assessment (EIA) was required and the Terms of Reference (TORs) (Appendix 1) were established by the National Environment and Planning Agency (NEPA) in order to outline the various aspects of the EIA. The EIA, " *Environmental Impact Assessment for the Princess Hotels and Resorts Green Island, Hanover"* was submitted to NEPA on 12 December 2019.

This Project falls under two categories of Natural Resources (Prescribed Areas); namely:

1. Hotel: Construction and Operation of Hotel or Resort Complex of 2001 to 3000 Rooms
2. Site Modification Projects: Construction of Overwater Rooms and Structures Over the Sea, Rivers or Ponds

2.2 STUDY AREA

2.2.1 Project Location

The proposed hotel property is located in Green Island, Hanover (Figure 2-1). The site shoreline is approximately 2.3 km in length consisting of rocky shoreline, sandy beach, and a mangrove coastline in some areas.

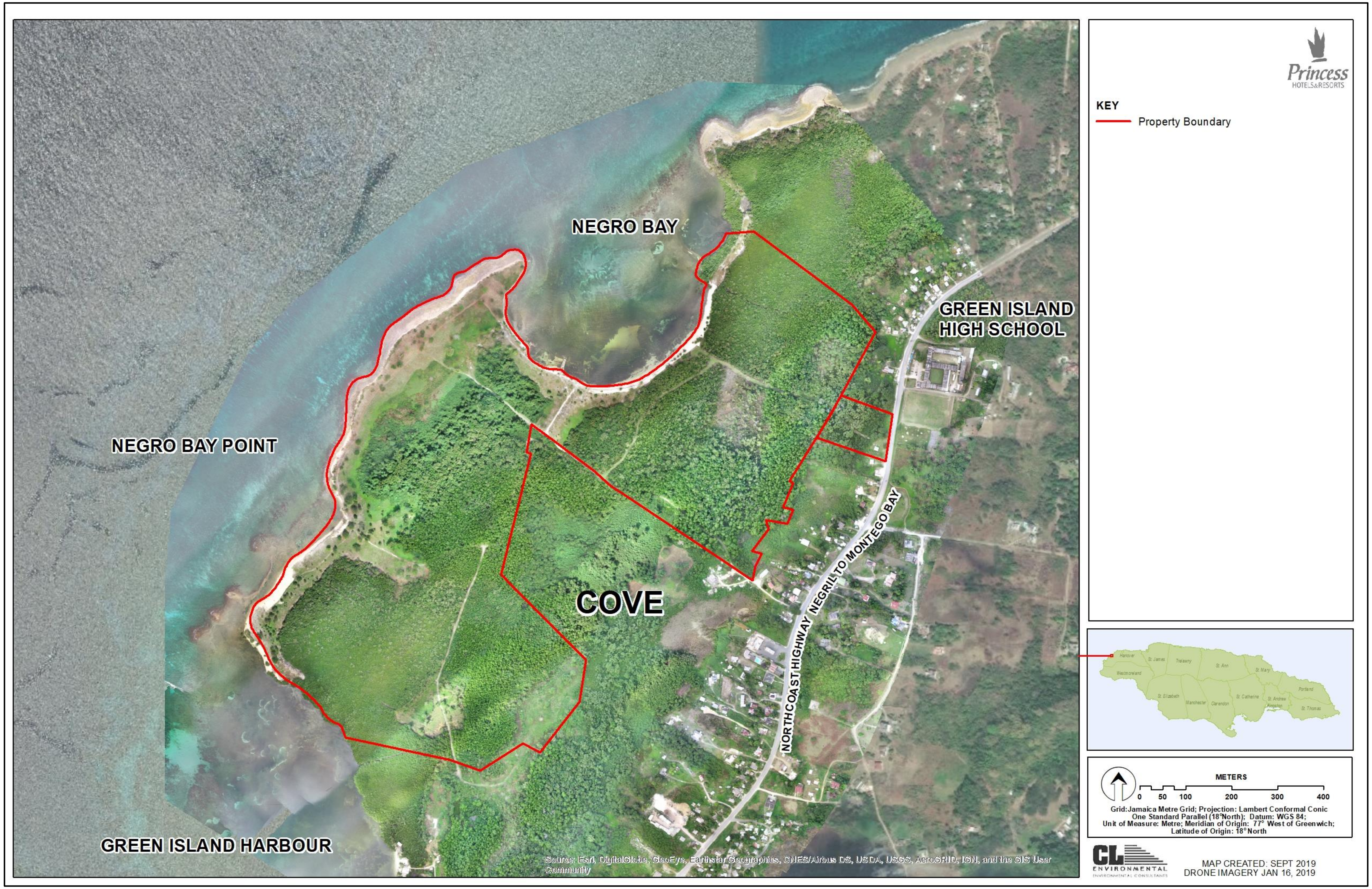


Figure 2-1 Project location map of Princess Hotel Hanover

2.3 SCOPE OF WORK

The proposed project falls under the category of “Hotel – Construction and operation of hotel or resort complex of 2001 to 3000 rooms” as well as the National Environmental and Planning Agency’s “Overwater Structure Planning Guidelines, 2016”. Environmental impacts from the construction and operation of the proposed hotel and overwater structures will potentially arise and it was considered imperative to evaluate these likely impacts, recommend mitigation strategies and potentially viable alternatives to the proposed project.

The Permit Application for the proposed project, *the Environmental Impact Assessment for the Princess Hotels and Resorts Green Island, Hanover* was submitted on 17 September 2019. It was decided that an Environmental Impact Assessment (EIA) was required and the Terms of Reference (TORs) (Appendix 1) were established by the National Environment and Planning Agency (NEPA) in order to outline the various aspects of the EIA. The specific tasks outlined in the approved TORs were executed by CL Environmental Co. Ltd.; the study team may be seen in

Appendix 2. This report serves to compile and present the findings of the EIA and ultimately provide a comprehensive evaluation of the proposed project. The EIA was submitted to NEPA on 12 December 2019.

2.3.1 General Methodology, Assumptions and Constraints

Modelling software and various equipment used for this EIA make certain assumptions when running/measuring various scenarios and parameters. Some of the models used and their assumptions are shown in Table 2-1.

Table 2-1 Modelling Software and associated assumptions

Modelling Software	Parameter Modelled	Assumptions/Limitations/Constraints
MIKE 21 -HD -SW -ST	Current Speed (m/s) Water Level (m MSL)	- MIKE21 HD/SW/ST is a coupled two-dimensional model. The effects of the depth changes of variables are averaged out by the models. - The coupled models require a high amount of CPU hours for processing and therefore long-term runs are limited. - In lieu of measured tides and wind for the area, the MIKE21 Astronomical Tides Model was used for tidal inputs and the wind from the NOAA deep water forecast was to force the model. - The MIKE21 astronomical tides used focuses only on the 12 major tidal components on a course global grid of 0.125^{0}. This may induce slight inaccuracies at the site as the lesser components are not included. - No wave runup/wind setup calculated by the SW model so there may be an underestimation of the flooding levels. Additional coupling with other models was done to limit this. - We assumed sandy areas had a mean thickness of 0.6m (in accordance with sediment probing for the area)
	Significant Wave Height (Hs (m)) Wave Direction (θ) Peak Wave Period (Tp)	
	Sand Transport (Sediment Load)	
SBEACH	Wave Setup/Wind Setup	- sBEACH is one-dimensional model that only focus on the cross-shore profile. The longshore effects are averaged out by the model. - sBEACH computes the wave energy dissipation with conservation of the wave set up, however the model does not represent wave run up, which must be added to produce final inundation levels.
LITDRIFT	Net Sediment Drift and Direction	- LITDRIFT is also a one-dimensional model and is not capable of accounting for the cross-shore effects. - Further, the profile is assumed to remain constant throughout the simulation; there is no morphology or response of the beach to wave conditions.

Modelling Software	Parameter Modelled	Assumptions/Limitations/Constraints
		- Despite these limitations, LITDRIFT provides valuable insights into the coastal processes occurring at the site.
HEC-HMS	Peak 24hr Rainfall Time of Concentration (Tc)	- SCS Type II Temporal Rainfall Distribution was assumed. - The 1:2500 topographic maps for the Hanover Parish was used to get all slope information. - Soil Type B (Shallow Loess or Sandy Loam or similar) was assumed based on visual inspections.

2.4 ORGANISATIONAL PROFILES

2.4.1 The Proponent

Princess Hotels and Resorts is a family owned business based in Spain operating 23 hotels. It has resorts in Spain and the Caribbean, located in the Canary Islands, Barcelona, Punta Cana (Dominican Republic) and Riviera Maya (Mexico).

2.4.1.1 Corporate Social Responsibility Princess Hotels & Resorts

Princess Hotels & Resorts is involved in a sustainable tourism development activity within its hotels. Everyday there is active work in its transversal Corporate Social Responsibility company programme. Princess Hotels & Resorts is aware of the responsibility it has with the environment and society. It's for this reason that a specific Corporate Social Responsibility programme has been developed in each destination.

We share the concerns about the environment, our society and the cultural surroundings. Sustainable development policies aim to generate good practices on:

- The Environment
- Society and Culture
- The guests
- The employees
- Suppliers

"We want to build a better world by offering excellence in hotel service through our most sustainable values" (Princess Hotels & Resorts, n.d.)

2.4.1.2 Sustainability Policy of Princess Hotels & Resorts

The hotel group Princess Hotels & Resorts in the Canary Islands is a family owned company that manages hotels in the Canary Islands and in other parts of the world. Since the environment is of vital importance for our business, we made a commitment to develop environmental protection activities, in order to achieve the goals of sustainable tourism.

Princess Hotels & Resorts have implemented an Environmental Management System based on the UNE-EN ISO 14001 standard, which includes all hotel and restaurant activities of each resort. The aim is total control of all environmental aspects, which may have a significant impact on the environment. This is why there is a commitment to:

- Allocate all necessary resources for the implementation and maintenance and continuous improvement of our environmental management, likewise, we will constantly review our environmental objectives and targets with our employees, in order to improve continuously
- Ensure compliance with all legal requirements in relation to the environment that affect our hotels in the Canary Islands, as well as to preserve the safety and health of our employees through equal opportunities and fundamental rights.
- Optimize consumption and use natural recourses - water, energy, fossil fuels – wisely. The importance of the sustainability of the resources used (low environmental impact) and respect for cultural resources and involvement with the local community, specific to each location where our hotels in the Canaries are located.
- Recognize the importance of environmental management appropriate to carry out an integrated control and prevention of pollution of the process variables that may affect the environment (emissions, noise, waste), especially waste that might affect the environment. Furthermore, we will control and minimize the use of polluting chemicals and the carbon footprint as much as possible.
- Looking for the cooperation of our customers, involve our local suppliers and especially maintain an effective communication with our employees by involving them in the system design and continuous training (Princess Hotels & Resorts, n.d.)

2.4.2 Project Consultant

C. L. Environmental Company Limited has been incorporated in Jamaica as a Limited Liability Company since August 2000. The Company provides consultancy services to both governmental and non-governmental agencies, local and overseas. The company comprises a range of professional skills and includes environmental scientists, marine ecologists, environmental engineers, waste management specialists, planners, industrial hygienists, environmental management systems specialists, environmental educators and quality Consultants. The team of Consultants and Scientists associated with C.L Environmental Company have over the years, worked on numerous environmental projects of which some were of national importance such as the Highway 2000 North South Link: Caymanas to Linstead and Moneague to Ocho Rios legs, National Programme of Action for Land Based Sources and Activities that Impact the Marine Environment, the Remediation of the American Airlines Flight 331 Accident Site at Norman Manley International Airport, the Ausjam Gold Mine Cyanide Spill in Clarendon, Environmental Assessment Road Rehabilitation Works for the Moneague Lake Flooding in St. Ann for Bouygues Travaux Publics and the Environmental Monitoring of the Falmouth Cruise Pier Development in Falmouth, Trelawny for the National Environment and Planning Agency (NEPA) to name a few.

The company has worked on numerous hotel projects. These include; RIU (Ocho Rios, Montego Bay and Negril), Royalton (Trelawny and Negril), H10 (Trelawny), Secrets (Montego Bay), Half Moon (Montego Bay), Grand Palladium (Hanover), Decameron (Montego Bay) and Karisma (Negril and St. Ann).

The environmental impact assessment capabilities of the company are built on a multidisciplinary group of professional associates who collectively have over eighty years of experience in environmental management. In addition, to their experience, the depth and diversity of the team provides us with strengths in policy development, organisational evaluation operational management, project management, noise modelling, water quality assessments, solid waste and medical waste management and waste treatment design and implementation. The combined inter disciplinary strength of this team and their regional and international experience, makes them highly suitable to undertake the proposed project.

3.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

3.1 ENVIRONMENTAL IMPACT ASSESSMENT FRAMEWORK

3.1.1 Rationale and Basis

An Environmental Impact Assessment (EIA) is "a structured approach for obtaining and evaluating environmental information prior to its use in decision-making in the development process. This information consists, basically, of predictions of how the environment is expected to change if certain alternative actions are implemented and advice on how best to manage environmental changes if one alternative is selected and implemented" (Bisset, 1996). The basis and rationale of an EIA has been summarised as follows (Wood):

- Beyond preparation of technical reports, EIA is a means to a larger end - the protection and improvement of the environmental quality of life.
- It is a procedure to discover and evaluate the effects of activities on the environment - natural and social. It is not a single specific analytical method or technique but uses many approaches as appropriate to the problem.
- It is not a science but uses many sciences in an integrated inter-disciplinary manner, evaluating relationships as they occur in the real world.
- It should not be treated as an appendage, or add-on, to a project, but regarded as an integral part of project planning. Its costs should be calculated as a part of adequate planning and not regarded as something extra.
- EIA does not 'make' decisions, but its findings should be considered in policy - and decision-making and should be reflected in final choices. Thus, it should be part of decision-making processes.
- The findings of EIA should focus on the important or critical issues, explaining why they are important and estimating probabilities in language that affords a basis for policy decisions.

3.1.2 Development Application and the EIA Process

3.1.2.1 National Environment and Planning Agency

The National Environment and Planning Agency (NEPA) is the government executive agency and represents a merger of the Natural Resources Conservation Authority (NRCA), the Town Planning Department (TPD) and the Land Development and Utilization Commission (LDUC). Among the reasons for this merger was the streamlining of the planning application process in Jamaica. The Agency is moving towards one application to NEPA for new developments and new modifications that will review and approve environmental aspects as well as planning, building control and zoning considerations. It is this agency that will review the Environmental Impact Assessment.

The National Environment and Planning Agency (NEPA) has been given responsibility for environmental management in Jamaica under the NRCA Act of 1991. Since the promulgation of the Act, the NRCA has been developing local standards. The Act was strengthened by supporting regulations, which became effective in January 1997.

3.1.2.2 Environmental Permit and License System

The Environmental Permit and License System (P&L) is administered by NEPA through the Applications Section. It was introduced in 1997 to ensure that all developments meet required standards and negative environmental impacts are minimized. Under the NRCA Act of 1991, the NRCA has the authority to issue, suspend and revoke environmental permits and licenses, as well as the power to request EIAs for a permit or for any activity in a prescribed area (entire island of Jamaica) where it is of the opinion that the environment is likely to have adverse effects due to the activities. An applicant for a Permit or License must complete a Permit Application Form (PAF) as well as a Project Information Form (PIF) for submission to the NRCA/NEPA.

3.1.2.3 General Procedures

The NRCA permit procedure is initiated by the submission of the Project Information Form (PIF) to the Authority. The PIF screening form is reviewed to determine whether an EIA is required and to begin determining areas of environmental significance, especially in waste discharge. Based on the review of the PIF, the NRCA advises if an EIA would be required for the proposed project and determines the scope of the EIA through proposed Terms of Reference (TORs). The TORs are proposed using NRCA guidelines and are ultimately approved by the NRCA. NRCA gives the approved final TORs for the proposed project; Appendix 1 shows those specific to this project.

The NRCA requires that the EIA include the following:

- A description of the present environment, i.e. physical, biological and social environment. This includes, for example, consideration of economic situations, cultural heritage and ecological preservation;
- A description of the significant impacts the environmental professionals expect the development to have on the environment, compared to the environment that would remain if there were no development. This will include indirect and cumulative impacts;
- An analysis of alternatives that were considered in order to consider means of minimising or eliminating the impacts identified above; and
- An Environmental Management Plan, which includes a Monitoring & Hazard Management Plan and an Auditing schedule.

The NRCA guidance on EIAs states that this process “should involve some level of stakeholder consultation in either focus groups or using structured questionnaires.” A draft EIA is submitted to the developer to solicit the proponents’ input into the description of the project (to check for accuracy of statements, and to enter into realistic discussions on the analysis of alternatives, as well as to inform the proponents of any other relevant legislation with which they must comply). Fourteen copies of the finalised draft are then submitted to NRCA, two to the client, and the consultant keeps one (17 in all are produced). The NRCA distributes these to various other public-sector institutions who sit on the Technical Committee (e.g. Water Resources Authority (WRA), Environmental Control Division in the Ministry of Health (ECD), Jamaica National Heritage Trust (JNHT)) for their comments. Typically, this depends on the nature of the project.

As deemed necessary by the NRCA, Public Meeting(s) are then held (see Appendix 3 for the full guidelines on public participation in EIAs), following the deposition of the Draft EIA at Parish Libraries (by the NRCA). A verbatim report of the public meetings is required, as well as a summary report of the main stakeholder responses which emerged. The comments of the NRCA, the other GOJ interests and the public are compiled and submitted in writing to the consultant not only for finalisation of the report, but for incorporation into the development's design. The NRCA then reviews this report again, and if further clarifications are needed, these are again requested. Once the NRCA is satisfied, the EIA is submitted to the Technical Committee of the NRCA Board for final approval. If the EIA is not approved, the proponents may appeal to the Office of the Prime Minister.

3.2 NATIONAL LEGISLATION

3.2.1 Development Control

3.2.1.1 The Town and Country Planning Act (TCP Act) 1957 (Amended 1987)

The Town and Country Planning Act (TCP Act) 1957 (Amended 1987) provides the statutory requirements for the orderly development of land through planning, as well as guidelines for the preparation of Development Orders. A Development Order is a legal document which is used to guide development in the area to which it applies, and the TCP Act is only applicable in an area where a Development Order exists. It constitutes land use zoning map/s, policy statements and standards relating to land use activities. Additionally, tree Preservation Areas and Conservation Areas (as specified areas the gazetted Development Orders) are two types of protected areas associated this Act.

The TCP Act establishes the Town and Country Planning Authority, which in conjunction with the Local Planning Authorities (Municipal Corporations and formerly Parish Councils), are responsible for land use zoning and planning regulations as described in their local Development Orders. The TCP Act is administered by the National Environment and Planning Agency. Specific to this project, associated local agencies are:

- **Negril Green Island Area Local Planning Authority (NGIALPA)**
- **Hanover Municipal Corporation** (formerly Hanover Parish Council)

The Development Order relevant to this is the **Negril and Green Island Area Development Order, 2015.**, which is "called in" by the TCPA. The Negril Green Island Area Local Planning Authority (NGIALPA) is the local planning authority responsible for the Negril and Green Island Area Development Order area. The main objectives of the NGIALPA are:

a. The orderly and progressive development of land described in the Development Order. However, the Negril Development Order area is "called in" by the TCPA and therefore the main functions of the NGIALPA are advisory and enforcement of planning control.
b. To administer the proper management of the assets of the NGIALPA.

It should be noted that the NGIALPA is not a Parish Council, however, has similar planning functions as other local planning authorities. The powers and duties of the NGIALPA are declared to be the powers and duties conferred or imposed on the local planning authority by the Town and Country Planning Act. The NGIALPA Board consists of representatives from the Hanover and Westmoreland Municipal Corporations and Negril organisations, including the Negril Area Environmental Protection Trust (NEPT), Negril Chamber of Commerce (NCC), and the Jamaica Hotel and Tourism Association (JHTA).

One of the main functions of interest to the project is the granting or refusal of permission for development, which is undertaken by the local planning authority. A local planning authority receives and considers development applications and having regard to the provisions of the Development Order, and any other material considerations, to which the land which is the subject of the application relates. The local planning authority may grant permission either unconditionally or subject to such conditions as the authority thinks fit or it may refuse permission. However, this function has been "called in" by the Town and Country Planning Authority. Any application for permission to develop land shall be referred to the TCPA instead of being dealt with by the NGIALPA, the local planning authority for the area. The NGIALPA appointees cannot approve these applications, however, recommends approval or refusal for applications for planning permission, which are then submitted to the TCPA for approval. Other applications which are not called in are processed and determined by the NGIALPA, for example, residential applications within an approved subdivision scheme.

3.2.1.2 Local Governance Act 2016

This Act is a consolidation of the following existing Acts, which were repealed once the new legislation was enacted:

- The Parish Councils Act (1887)
- The Kingston and St. Andrew Corporation Act (1923)
- The Municipalities Act (2003)
- The Parochial Elections (Modifications) Act (1979)

This Act introduces new concepts and tenets which reflect a modern approach to local governance, and which strengthen local self-management. Local Authorities (formerly referred to as Parish Councils) are categorised as Municipal Corporations and City Municipalities or Town Municipalities. The Hanover Municipal Corporation is the Local Authority with responsibility for development within the study area.

3.2.1.3 The Beach Control Act 1956 and the Beach Control (Amendment) Act 2004

This Act was passed in 1956 to ensure the proper management of Jamaica’s coastal and marine resources by means of a licensing system. This system regulates the use of the foreshore and the floor of the sea. In addition, the Act speaks to other issues including access to the shoreline, rights related to fishing and public recreation and establishment of marine protected areas. Under section 5 of this act, it is an offence to encroach on the foreshore or floor of the sea for a public or commercial purpose without a licence.

The *Beach Control (Licensing) Regulations 1956* require a permit for any works on a beach, coastline or foreshore. Application for this permit must be made to NEPA. The requirements of the permit include a Notice of Application to be posted on the landward and seaward sides of the property and said Notice should be served on adjoining neighbours. Member of the Natural Resources Conservation Authority or any officer authorised by the Authority may conduct investigations to ensure compliance with licence and require information to be furnished.

In addition, the following regulations also fall under the Beach Control Act 1956:

- *The Beach Control (Hotel, Commercial and Public Recreational Beaches) Regulations 1978*
- *The Beach Control (Safety Measures) Regulations 1957*

3.2.1.4 Overwater Structure Planning Guidelines, 2016

The decision to develop planning guidelines on overwater structures was made in recognition of the growing interest in developing overwater rooms in the tourism sector in Jamaica. The scope of this document is limited to the establishment of overwater structures in commercial, tourism resorts and the establishment of structures related to navigation such as docks, jetties, piers and wharfs and encroachments such as groynes should be guided by the Beach Control Act.

The following statements have been developed to guide the development of overwater structures

a. The development of overwater structures **will not be permitted** in the following areas:
    - Areas within 100m of a coral reef.
    - Declared public bathing and fishing beaches
    - Fish sanctuaries
    - Marine protected areas
    - Navigational channels
    - Within 100m of river mouths and drainage features
    - Areas within 30 m of mangroves and riparian forest
    - Exposed and high energy coastline
    - Within 30m of underwater infrastructure e.g. cables and pipelines
    - Proposed development areas with 30% or more of seagrass coverage
b. All potential developments will require an Environmental Impact Assessment. The Terms of Reference of the EIA will address concerns specific to the development and must be approved by NEPA.
c. The developer of any overwater structure must obtain the necessary licence and permit from the NRCA before proceeding with the development.
d. All overwater structures will be required to conform to the environmental standards for the prevention of pollution.

e. A performance bond will be required for companies or persons permitted/licensed to construct an overwater structure. The performance bond seeks to ensure compliance with the terms of the permit/licence including environmental management, monitoring and decommissioning.
f. Only persons owning (titled) or in possession of development rights of the adjoining lands to the foreshore and floor of the sea shall be permitted to construct overwater structures.
g. All developments on the seafront property will be required to leave as land reservation an area of usable land, which may include open space, equivalent to or larger than the area of the footprint of the overwater structures to be located along the coastline of the property.
h. The permitting agency will apply a policy of no-net-loss of critical habitats, such as, but not limited to riparian and littoral forests, fringing mangroves, corals and sea-grass beds.
i. Only a maximum of 20% of the total length of sea frontage will be permitted for overwater structures; and, the footprint of the overwater structures area shall not exceed 10% of the developer's property.
j. The location of an overwater structure must not conflict with zoning objectives, Conservation Management Plans, or other management measures within a zoned area.
k. No person will be allowed ownership of the land (seabed) where overwater structures are being constructed but would be permitted to have long-term leases or concessions.
l. The Commissioner of Lands will negotiate the terms of the lease and determine the annual and other fees to be paid for the lease of the floor of the sea contingent upon obtaining a permit/licence from NEPA.
m. All overwater structures are to be of "Green Buildings" standard of Passive Climatic Design.
n. The design and outlay of the overwater structure must be such that it blends with the natural surroundings and maintains as much as possible a tropical look.
o. All facilities are encouraged to use renewable energy sources.
p. Public access to the licensed area for legitimate purposes and during emergency situations shall be permitted and accounted for as a condition of the licence.

General guidelines for the development of overwater structures intended to provide guidance for the project proponent are also listed in this draft document. In addition, it is stated that detailed and specific conditions and guidelines will be provided on a case-by-case basis as part of the licence/permit process. These guidelines, while being flexible, are intended to ensure that the natural ecological processes are not unduly disrupted and that marine resources are protected from construction-related activities.

3.2.1.5 NRCA Guidelines for the Planning, Construction and Maintenance of Facilities for Enhancement and Protection of Shorelines

This document offers guidance on the NRCA permitting process, the environmental aspects, and the coastal engineering planning and design of projects conceived for the protection and enhancement of shorelines. With such guidance., it is intended that the undesirable environmental impacts that these types of projects can cause will be eliminated or mitigated.

Under the *Permitting Procedures* section, it is stated that certain types of activities in the coastal zone give rise to particular effects, and therefore it is important for all concerned to be aware of the particular types of negative effects that are likely to arise from a given type of project. Project Sponsors are therefore encouraged to make contact with NRCA (NEPA) from the very earliest stages of project planning.

3.2.1.6 Building Act 2016

The Building Act 2016 repeals the Kingston and St. Andrew Building Act and the Parish Councils Building Act and makes new provisions for the regulation of the building industry. It aims to facilitate the adoption and efficient application of national building standards (National Building Code of Jamaica) for ensuring safety in the built environment, enhancing amenities and promoting sustainable development. A "building" is described as a domestic building, a public building, a building of the warehouse class and any other physical structure, whether a temporary structure or not, any part of the structure, and any architectural or engineering product or work erected or constructed on, over or under land or the sea or other body of water.

For the purposes of this Act, the Hanover Municipal Corporation is designated as the Local Building Authority for the respective area. A person who proposes to carry out building work must apply to the relevant Local Building Authority for the appropriate building permit. A person shall not carry out any building work unless the respective building permit has been issued; where applicable, a planning permit has been issued under the Town and Country Planning Act; and the work is carried out in accordance with the building permit, the provisions of this Act, the National Building Code, or of any other regulations made under this Act.

3.2.1.7 The Jamaica National Heritage Trust Act 1985

The Jamaica National Heritage Trust Act established the Jamaica National Heritage Trust (JNHT) and has been in operation since 1985. The main goal is the preservation and protection of the country's national heritage. The Act states the following offences are liable to a fine and/or imprisonment:

- Wilfully defacing, damaging or destroying any national monument or protected national heritage;
- Wilfully defacing, destroying, concealing or removing any mark affixed or connected to a national monument or protected national heritage;
- Altering any national monument or marking without the written permission of the Trust;
- Removing any national monument or protected national heritage to a place outside of Jamaica.

3.2.1.8 The Mining Act 1947 (Amended 1995)

The Mining Act provides the legal framework governing mining and its operations. It also indicates the sanctions or penalties for non-compliance. According to this Act, any person who prospects or mines otherwise than in accordance with the provisions unlawful of the Act shall be guilty of unlawful prospecting or unlawful mining. The Mining Act details provisions regarding prospecting rights and licenses; mining leases and operation; passageways; and possessions and purchase of materials. *The Mining Regulations 1947* and *the Mining (Safety and Health) Regulations 1977* are the two ancillary regulations associated with this Act. It is administered by the Mines and Geology Division of the Ministry of Transport and Mining.

3.2.1.9 The Quarries Control Act 1984 and the Quarries Control (Amendment) Act 1994

The Quarries Control Act is administered by the Mines and Geology Division It regulates the extraction of material such as sand, marl, gypsum, and limestone for construction purposes. Quarry zones and licenses, quarry tax, enforcement, safety, Quarry Advisory Committee, fines for illicit quarrying and bonds for restoration are addressed in this act. A license is required for establishing or operating a quarry, unless the Minister decides to waive this requirement based on the volume of material to be extracted (if the mineral to be extracted is less than 100 cubic metres, a license may not be required).

3.2.1.10 The Exclusive Economic Zone Act 1993

The Exclusive Economic Zone Act is designed to protect the living and non-living resources in the Exclusive Economic Zone (EEZ). It speaks to the establishment of the EEZ, a marine zone prescribed by the *United Nations Convention on the Law of the Sea* with its inner limit the boundary line of the seaward limit of the territorial sea (and subject to subsection (3) of the Act) and its outer limit two hundred nautical miles from the baselines from which the breadth of the territorial sea is measured. The Act stipulates conditions for the exploration for and exploitation of living and non-living resources of the zone, in addition to the powers and duties of marine officers.

It should be borne in mind during the construction phases of the Project, that under this Act, it is an offence, to exploit living and non-living creatures and conduct research without a licence.

3.2.1.11 The Maritime Areas Act 1996

Under this Act, Jamaica is declared an archipelagic State and defines the internal waters as areas of the sea which are on the landward side of the closing lines within the archipelagic waters. Stipulations regarding infrastructure within and passage through the archipelagic waters are made as well as limits and jurisdictions regarding the contiguous zone and continental shelf. Offenses under this Act must be borne in mind during construction activities. Offenses include the refusal, neglect or failure to comply with directive of Marine Officer or to produce licence to Marine Officer and participation while on the vessel in acts contrary to Jamaica’s peace, order or security.

A permit or licence is not required in order to comply with this Act.

3.2.1.12 The Main Roads Act 1932

The Main Roads Act of 1932 details the legal basis pertaining to main roads and specifically looks at management, laying out of roads, taking of lands, encroachments, offences, lights and carriages, power to arrest and other legalities. In section 5 of this Act, it states that the Minister has the power to declare other roads or parts thereof to be main roads and to also declare that a main road is no longer such. The Chief Technical Director (with permanent staff), under the directive of the Minister, is responsible for the laying out, making, repairing, widening, altering, deviating, maintaining, superintending and managing main roads, and controlling the expenditure of allotted moneys.

3.2.2 Environmental Conservation

3.2.2.1 Protected Areas System Master Plan: Jamaica 2013 – 2017

The Protected Areas System Master Plan (PASMP) sets out guidelines for establishing and managing a comprehensive system of protected areas that supports national development by contributing to long-term ecological viability; maintaining ecological processes and systems; and protecting the country's natural and cultural heritage (National Environment and Planning Agency). The PASMP is consistent with several national policies and plans, including the Policy for Jamaica's System of Protected Areas 1997, the National Strategy and Action Plan on Biological Diversity in Jamaica (2003) and Vision 2030 Jamaica: National Development Plan (2009). It is also a requirement under the Convention for Biological Diversity's (CBD's) Programme of Work for Protected Areas (PoWPA).

Existing protected area categories in Jamaica are listed in Table 3-1, Table 3-2 and Table 3-3. The NRCA/NEPA is responsible for areas declared/designated under the acts it administers, including the Wild Life Protection and Natural Resources Conservation Authority Acts (sections 3.2.2.5 and 3.2.2.3 respectively). In addition, a number of other government entities (such as the Forestry Department, Fisheries Division and Jamaica National Heritage Trust), local management entities, non-governmental entities, private sector and individuals are outlined as important role players as well. Indeed, responsibility for protected area management has been a shared endeavour and this collaborative approach to protected area management will continue under the PASMP (National Environment and Planning Agency).

Table 3-1 Existing categories of protected areas in Jamaica (January 2012) - protected area system categories

Source: (National Environment and Planning Agency)

CATEGORY	RESPONSIBLE AGENCY	LAW
Protected Area	Forestry Department: Ministry of Economic Growth and Job Creation (MEGJC).	Forest Act, 1996 and Forest Regulations
	National Environment and Planning Agency (NEPA): MEGJC	NRCA Act, 1991
	NEPA: MEGJC	Beach Control Act, 1956
National Park	NEPA: MEGJC	NRCA Act, 1991
Marine Park	NEPA: MEGJC	NRCA Act, 1991
Environmental Protection Area	NEPA: MEGJC	NRCA Act, 1996
Forest Reserve	Forestry Department: MEGJC	Forest Act, 1996 and Forest Regulations
Special Fishery Conservation Area	Fisheries Division: Ministry of Industry, Commerce, Agriculture and Fisheries (MICAF)	Fisheries Act, 2018
National Monument	Jamaica National Heritage Trust (JNHT) Ministry of Youth and Culture (MYC)	JNHT Act, 1985
Protected National Heritage	JNHT: MYC	JNHT Act, 1985
Game Sanctuary	NEPA (NRCA): MEGJC	Wildlife Protection Act, 1945
Game Reserve	NEPA (NRCA): MEGJC	Wildlife Protection Act, 1945

Table 3-2 Existing categories of protected areas in Jamaica (as at 1 January 2012) - other designations not considered part of the system

Source: (National Environment and Planning Agency)

CATEGORY	RESPONSIBLE AGENCY	LAW
Tree Order Preservation	Local Authority (Town and Country Planning Authority): MEGJC and Local Government Department, through Local Authorities	Town and Country Planning Act, 1958
Conservation Area	NEPA (Town and Country Planning Authority, Local Authorities): MEGJC	Town and Country Planning Act, 1958
Protected Watershed	NEPA (NRCA): MEGJC	Watershed Act, 1963 Protection

Table 3-3 Existing categories of protected areas in Jamaica (January 2012) - international designations

Source: (National Environment and Planning Agency)

CATEGORY	RESPONSIBLE AGENCY	CONVENTION
Ramsar Site	NEPA (NRCA): MEGJC	Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention)
World Heritage Site	Jamaica National Heritage Trust: MYC	World Heritage Convention

The proposed study falls within an Environmental Protection Area (EPA), namely the Negril Environmental Protection Area (Figure 3-1 and Figure 3-2). Environmental Protection Areas (EPAs) typically are large areas of mixed and complex ownership and use with interlinked ecological systems. To achieve environmental protection, they require coordinated management of the whole area by a variety of means, including use of Prescribed Area regulations. Primary uses and management authority will vary by zones that may be set forth in an environmental policy framework or determined later in a management plan. EPAs are not exclusive and may contain other types of protected areas such as fish sanctuaries, game or nature reserves.

Environmental non-government organisations play a key role in the management of protected areas. NEPA/NRCA are responsible for overall management but for partnerships with various NGO's, The Negril Area Environmental Protection Trust (NEPT), an umbrella environmental NGO representing most of the smaller NGOs and CBOs in Negril is responsible for the management of the Negril Environmental Protection Area, whilst the Negril Marine Park management entity is the Negril Coral Reef Preservation Society (NCRPS).

The southern-most section of the project site falls within the Green Island and Haughton Cove Environmental Replenishment Zone (ERZ) (Figure 3-3). Further details on the ERZ can be seen in Section 6.2.1.

3.2.2.2 Policy for the National System of Protected Areas 1997

This legislative instrument is a White Paper and essentially proposes a comprehensive protected areas system for Jamaica. Six types of protected areas are proposed in order to encompass the diverse natural resources and landscape, and are comparable to those of the IUCN (International Union for Conservation of Nature) [1]:

1) National Nature Reserve/Wilderness Area (Equivalent to IUCN Category I)
2) National Park, Marine Park (Equivalent to IUCN Category II).
3) Natural Landmark/National Monument (Equivalent to IUCN Category III)
4) Habitat/Species Management Area (Equivalent to IUCN Category IV)
5) National Protected Landscape, or Seascape (Equivalent to IUCN Category V)
6) Managed Resource Protected Area (Equivalent to IUCN Category VI)

[1] It should be noted that since the publication of the Policy for Jamaica's System of Protected Areas 1997, the IUCN has revised the categories system and guidelines (http://cmsdata.iucn.org/downloads/guidelines_for_applying_protected_area_management_categories.pdf)

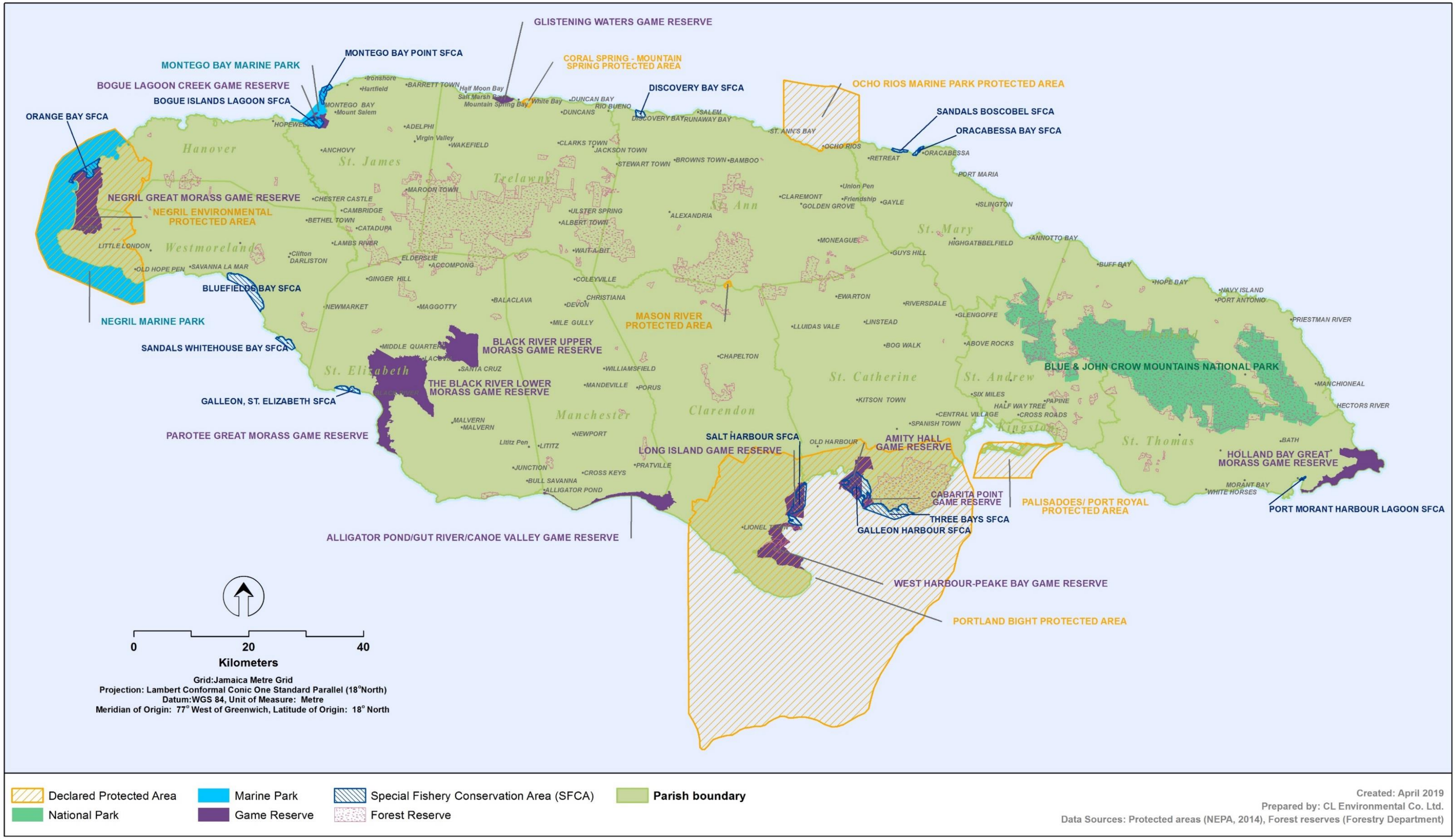


Figure 3-1 Protected areas system in Jamaica

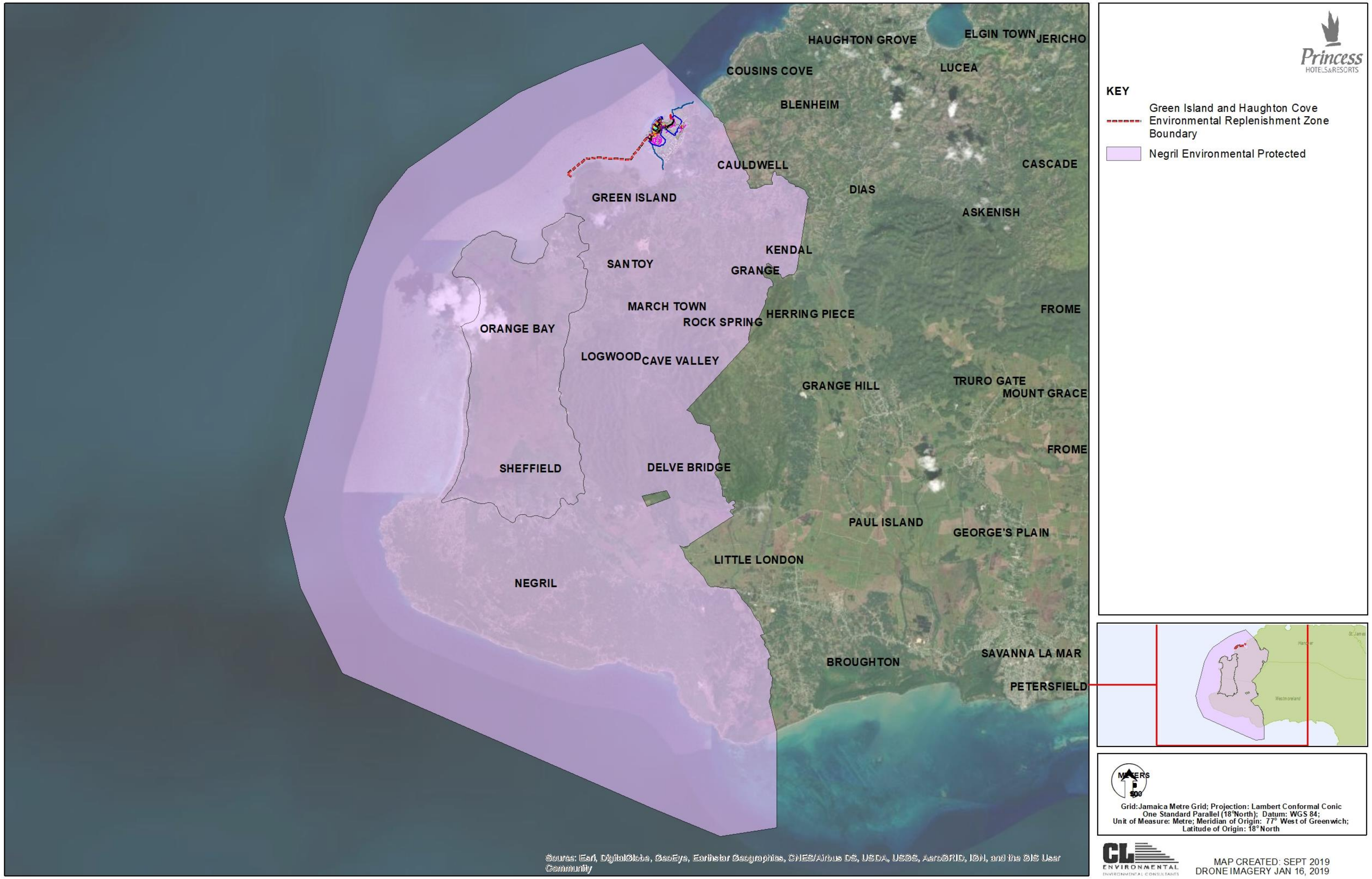


Figure 3-2 Negril Environmental Protected Area in relation to project site

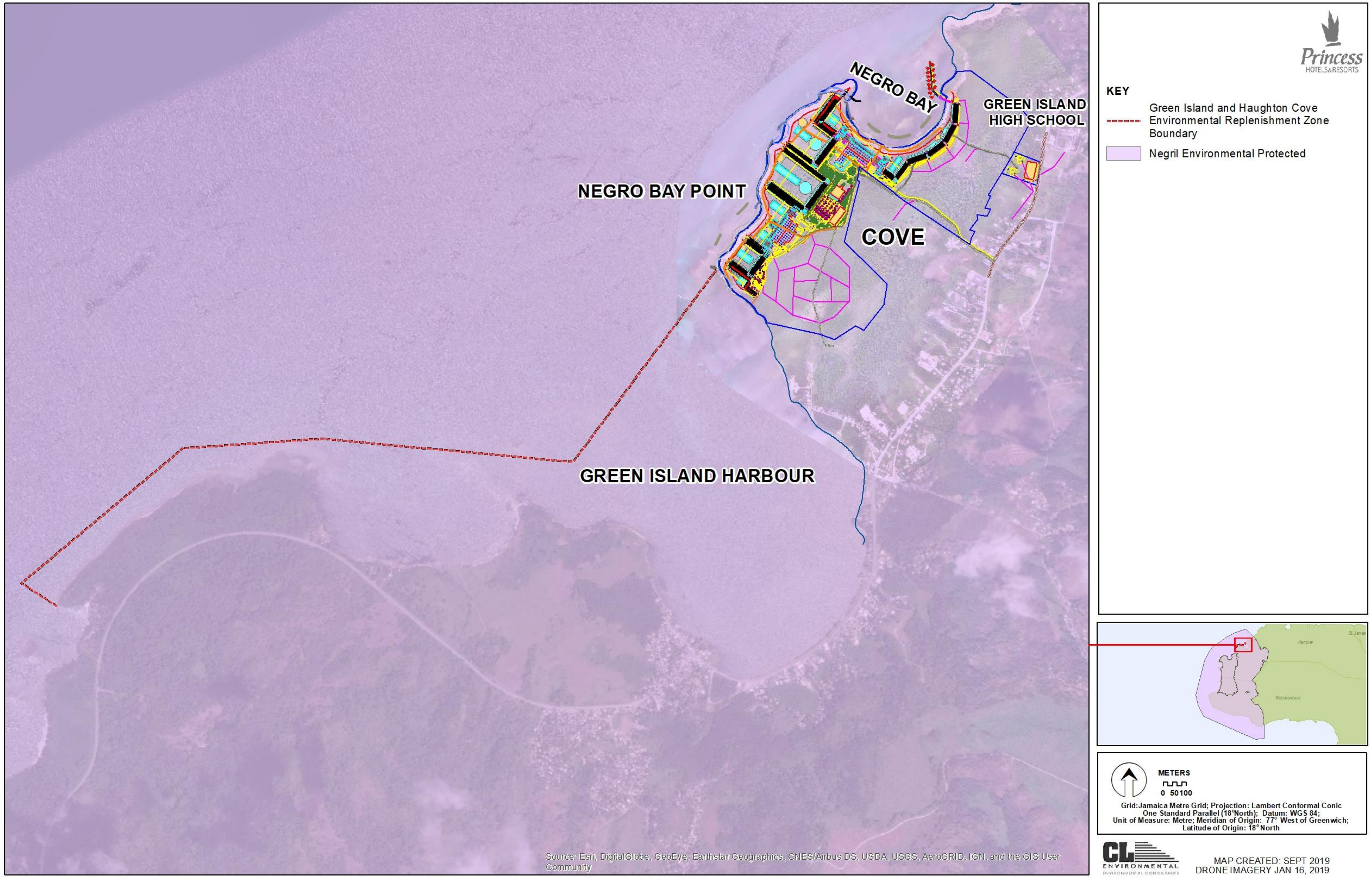


Figure 3-3 Close-up of protected area showing Green Island and Haughton Cove Environmental Replenishment Zone boundary

3.2.2.3 Natural Resources Conservation Authority Act 1991

The Natural Resources Conservation Authority Act (NRCA) is considered Jamaica's umbrella environmental law. The purpose of the Act is to provide for the management, conservation and protection of the natural resources of Jamaica. This Act was passed in the Jamaican Parliament in 1991 and subsequent to this, the Natural Resources Conservation Authority (NRCA) was established. The NRCA Act, under Sections 9 and 10 specifies that an Environmental Impact Assessment (EIA) is required from an applicant for a permit for undertaking any new construction, enterprise or development. It also speaks to the designation of national parks, protected areas etc.

The Act also gave power of enforcement of a number of environmental laws to the NRCA, namely the *Beach Control Act*, *Watershed Act* and the *Wildlife Protection Act*, as well as a number of regulations and orders including:

- *The Natural Resources (Permit and Licences) Regulations 1996 and* (Amendment) Regulations *2015;*
- *Natural Resources (National Parks) Regulations 1993 and (Amendment) Regulations 2003;*
- *The Natural Resources (Marine Parks) Regulations 1992, (Amendment) Regulations 2003,* and *(Amendment) Regulations, 2015;*
- *The Natural Resources (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) Order 1996* and *(Amendment) Order 2015;*
- *The Natural Resources Conservation (Wastewater and Sludge) Regulations, 2013.*

The Natural Resources Conservation (Permit and Licences) Regulations 1996 and (Amendment) Regulations 2015

A permit and licencing system was established under these regulations in order to control the undertaking of any construction or development of a prescribed nature in Jamaica and the handling of sewage or trade effluent and poisonous or harmful substances discharged into the environment.

The Natural Resources (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) Order 1996 and (Amendment) Order 2015

The Natural Resources (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) Order (1996) and the Permits & Licensing Regulations was passed as a result of section 9 of the NRCA Act. Section 9 of the NRCA Act declare the entire island and the territorial sea as a 'prescribed area', in which specified activities require a permit, and for which activities an environmental impact assessment may be required. The major amendment made in 2015 was the substitution of the Categories of Enterprises, Construction and Development (Column A), which lists the various activities, by category, for which a permit is required. As discussed previously, an EIA was required for the proposed project and this report fulfils one component of the EIA process.

3.2.2.4 Negril Environmental Protection Plan (EPP) 1997

The Negril Environmental Protection Area (EPA) was declared in November 1997 and encompasses the Negril watershed, coastal, and marine areas, as well as the Green Island areas. The aim of this protected area is to promote sustainable development. It is therefore significant that the EPA overlaps with the proposed Development Order area under the Town and Country Planning Act. The managing body, the Negril Area Environmental Protection Trust (NEPT) worked closely with the two most relevant government agencies – the NRCA and the NGIALPA to develop an EPP to guide environmental activities within the EPA.

Part of EPA management is to coordinate environmental activities between the various groups in the area by sitting on or leading committees. These include the Norman Manley Sea Park Management Committee, Greening Negril Steering Committee, NGIALPA Board, Environmental Legislation Enforcement Committee and the Resort Board. In addition, NEPT reminds other organisations of the role that they should be playing in the management of the EPA.

3.2.2.5 Wildlife Protection Act 1945 and Wildlife Protection (Amendment of Second and Third Schedules) Regulations 2016

The Wildlife Protection Act of 1945 is mainly concerned with the protection of specified faunal species and is the only statute in Jamaica specifically designated to this. This Act protects several rare and endangered faunal species and the Wildlife Protection (Amendment of Second and Third Schedules) Regulations 2016 provides substitutions for the Second and Third Schedules of the principal Act which lists these species. For these reasons, biological assessments were included as part of the biological surveys.

The establishment of two types of protected areas, namely Game Sanctuaries and Game Reserves is authorized under this Act. A Game Sanctuary / Game Reserve is a parcel of land, body of water or area comprising both land and water within which, the hunting of animals (including birds) removal of eggs or the nest of any bird and the use or possession of any dog, gun, catapult or any other weapon which could be used to hunt any animals or birds is prohibited. In addition, all Forest Reserves are also designated as Game Reserves and form part of the Protected Areas System of Jamaica. It is important to note however, that not all protected areas prohibit hunting (National Environment and Planning Agency, 2017). Any person found in a Game Sanctuary /Game Reserve in possession of any wild animal, bird, bird’s eggs or nests, will be presumed to be in violation of the WLPA. It is also important to note that for each Game Sanctuaries/Game Reserve, there is a 50-meter distance from the boundary; this is called a protective zone (National Environment and Planning Agency, 2017).

3.2.2.6 The Endangered Species (Protection, Conservation and Regulation of Trade) Act 2000 (Amended 2015)

The Endangered Species (Protection, Conservation and Regulation of Trade) Act was created in 2000 in order to ensure the codification of Jamaica’s obligations under the Convention for the International Trade in Endangered Species of Wild Fauna and Flora. This Act governs international and domestic trade in endangered species in and from Jamaica. The regulations associated with this Act were amended in 2015 and include updated fees for the various permits and certificates granted through this legislation.

3.2.2.7 Water Resources Act 1995

The Water Resources Act (1995) established the Water Resources Authority (WRA), which is authorized to regulate, allocate, conserve and manage the water resources of the island. Section 25 advises that a proposed user will have to obtain planning permission, if this is a requirement, under the Town and Country Planning Act. In addition, under Section 21 it states that if the water to be used will result in the discharge of effluents, an application for a license to discharge effluents will have to be made to the Natural Resources Conservation Authority or any other relevant body as indicated by the Minister.

3.2.2.8 Draft Policy and Regulation for Mangrove & Coastal Wetlands Protection

As outlined in this draft policy, the Government of Jamaica has adopted the policy and regulation in order to promote the management of coastal wetlands. The policy seeks to:

- Provide protection against dredging, filling, and other development;
- Designate wetlands as protected areas;
- Protect wetlands from pollution particularly industrial effluent sewage, and sediment;
- Ensure that all developments planned for wetlands are subject to an Environmental Impact Assessment (EIA);
- Ensure that traditional uses of wetlands are maintained.

3.2.2.9 Coastal Management and Beach Restoration Guidelines: Jamaica

These guidelines compliment Vision 2030 Jamaica and provide a tool for coastal stakeholders, including advice at the community level to ensure coastal management is undertaken in a sustainable way with consideration of wider impacts on the environment. Different management approaches are suggested for the coastline of Jamaica, which in turn influence the site-specific interventions considered appropriate. Progressive steps to follow from project inception through to design and obtaining planning permission for projects within the coastal zone are described. A number of design outcomes are required to be assessed to ensure that the intervention does not adversely affect the environment, is designed to be resilient and does not impact other sites along the coastal zone.

The adequacy of the governance structure and institutional base is considered a key aspect and the existence of national organisations with clear mandates, roles, responsibilities, and capacities is described as vital to the successful management of Jamaica's coastal resources.

3.2.2.10 Towards an Ocean and Coastal Zone Management Policy in Jamaica 2000

The Council on Ocean and Coastal Zone Management was established in 1998, with responsibility of defining a national policy for Ocean and Coastal Zone Management. The aim of this policy document is to develop a policy that will "enhance the contribution of economic sectors to the integrated management of coastal areas by developing awareness in sector line agencies and resource users." The document recognises the extensive use and resulting degradation of coastal and ocean resources in Jamaica, including coral reefs, mangroves and seagrass beds, as well as non-living resources such as sand.

3.2.2.11 Towards a Beach Policy for Jamaica (A Policy on the Foreshore and the Floor of the Sea) 2000 (DRAFT)

This green paper recognizes the value of beaches in Jamaica and importance of proper management and protection. It was developed in order to review and update existing policies, as well as prepare a comprehensive policy that considered new areas of concern at the time, including erosion and pollution. The policy seeks to balance, the different interests of the main users of the beach - the public, the private sector and fishermen.

3.2.2.12 National Policy for the Conservation of Seagrasses 1996 (DRAFT)

This policy is in its drafting stage and was created in recognition of the values that seagrass possesses. The issuing of licenses or permits for development activities including dredging and the disposal of dredged material which have the potential to affect seagrass beds are covered by this draft policy. Though a draft policy at present, the value of seagrass ecosystems should be kept in mind and efforts must be made to conserve these habitats as best as possible. For these reasons, marine assessments were included as part of the biological surveys.

3.2.2.13 Coral Reef Protection and Preservation Policy and Regulation 1997 (DRAFT)

This draft policy and regulation document aims to regulate coastal zone development as it relates to coral reef destruction and or degradation. It discusses the functions and uses of coral reefs, as well as the various issues affecting coral reef ecosystems. The aim of the policy is to ensure the conservation of coral reefs in order to sustain their ecological and socio-economic functions. Though in its drafting stage, the value of coral reef ecosystems should be kept in mind and efforts must be made to avoid destruction and degradation of these habitats as best as possible. For these reasons, marine assessments were included as part of the biological surveys.

3.2.2.14 The Fisheries Act, 2018

The Fisheries Act, 2018, is the overarching instrument relating to fishing activities within Jamaica. This Act repeals the previous Fishing Industry Act, 1975. The Fisheries Act, 2018 speaks to provision of efficient and effective management and sustainable development of fisheries, aquaculture and other related activities in accordance with internationally recognized norms, standards and best practices. The Fisheries Act, 2018 gives the Fisheries Division, of the Ministry of Industry, Commerce, Agriculture and Fisheries (MICAF), the responsibility for licensing fisher folk and fishing boats (whether for sport, recreation or commercial), creation and demarcation of Special Fishery Conservation Areas, protection of the various fisheries resources via establishment of closed seasons, and fines/penalties for illegal catching or selling of fish.

3.2.3 Public Health & Waste Management

3.2.3.1 Water Quality Standards

The NRCA has primary responsibility for control of water pollution in Jamaica. National standards for ambient marine water and freshwater are shown in Table 3-4 and

Table 3-5 respectively. For drinking water, World Health Organisation (WHO) standards are utilized and these are regulated by the National Water Commission (NWC).

Table 3-4 Draft national ambient marine water quality standards for Jamaica, 2009

Source: National Environment and Planning Agency (NEPA)

Parameter	Measured as	Standard Range	Unit
Phosphate,	P*	0.001-0.003	mg/L
Nitrate,	N**	0.007-0.014	mg/L
BOD_5	O	0.0-1.16	mg/L
pH		8.00-8.40	
Total Coliform		2-256	MPN/100mL
Faecal Coliform		<2-13	MPN/100mL

*Reactive phosphorus as P
**Nitrates as Nitrogen

Table 3-5 Draft national ambient freshwater water quality standards for Jamaica, 2009

Source: National Environment and Planning Agency (NEPA)

Parameter	Measured as	Standard Range	Unit
Calcium	(Ca)	40.0-101.0	mg/L
Chloride	(Cl^-)	5.0- 20.0	mg/L
Magnesium	(Mg^{2+})	3.6- 27.0	mg/L
Nitrate	(NO_3^-)	0.1- 7.5	mg/L
Phosphate	(PO_4^{3-})	0.01 - 0.8	mg/L
Potassium	(K^+)	0.74- 5.0	mg/L
Silica	(SiO_2)	5.0- 39.0	mg/L
Sodium	(Na^+)	4.5- 12.0	mg/L
Sulfate	(SO_4^{2-})	3.0- 10.0	mg/L
Hardness	($CaCO_3$)	127.0-381.0	mg/L (as $CaCO_3$
Biochemical Oxygen Demand	(O)	0.8- 1.7	mg/L
Total Dissolved Solids		120.0-300	mg/L
pH		7.00- 8.40	
Conductivity		150.0-600	µS/cm

Standards for industrial (trade effluent) and sewage discharge into rivers and streams are stipulated within the Natural Resources Conservation (Wastewater and Sludge) Regulations, 2013 (Table 3-6, Table 3-7 and Table 3-8).

Table 3-6 Sewage Effluent Standards for new and existing plants

Table 1—*Sewage Effluent Standards for Existing Plants*

PARAMETER	EFFLUENT LIMIT
BOD_5	20 mg/L
TSS	30 mg/L
Nitrates (as Nitrogen)	30 mg/L
Phospates	10 mg/L
COD	100 mg/L
pH	6-9 pH units
Faecal Coliform	1000 MPN/100 ml.
Residual Chlorine	1.5 mg/L

Table 2—*Sewage Effluent Standards for Plants other than Existing Plants*

PARAMETER	EFFLUENT LIMIT
BOD_5	20 mg/L
TSS	30 mg/L
Total Nitrogen	10 mg/L
Phosphates (PO_4-P)	4 mg/L
COD	100 mg/L
pH	6-9 pH
Faecal Coliform	1000 MPN/100 ml.
Residual Chlorine	1.5 mg/L
Floatables	not visible

Table 3-7 Sewage Effluent Standards for use in Irrigation

Table 4—*Standards for Sewage Effluent to be used for Irrigation*

PARAMETER	STANDARD LIMIT
Oil and Grease	10 mg/L
Total Suspended Solids (TSS)	1.5 mg/L
Residual Chlorine	0.5 mg/L
Biochemical Oxygen Demand (BOD_5)	15 mg/L
Chemical Oxygen Demand (COD)	<100 mg/L
Faecal Coliform	12 MPN/100ml.

Table 3-8 Industrial Trade Effluent Standards

Table 3—*Trade Effluent Standards*

PARAMETER	TRADE EFFLUENT LIMIT
Ammonia/ammonium measured as NH_4	1.0 mg/L
Barium	5.0 mg/L
Beryllium	0.5 mg/L
Biological oxygen demand (BOD)	<30 mg/L
Boron	5.0 mg/L
Calcium	No standard
Chemical Oxygen Demand (COD)	<100mg/L or <0.01 kg/1000 kg product
Chloride	300 mg/L
Colour	100 TCU
Cyanide (free)	0.1 mg/L
Cyanide (Total as CN)	0.2 mg/L
Detergent	15 mg/L
Dissolved oxygen (DO)	>4mg/L
Faecal Coliform	<100 MPN/100 ml
Fluoride	3.0 mg/L
Iron	3.0 mg/L
Magnesium	No standard
Manganese	1.0 mg/L
Nitrate as NO_3	10 mg/L
Oil and Grease	10 mg/L or < 0.01 kg/1000 kg product
PH	6.5 - 8.5
Phenols	0.1 mg/L
Phosphate as PO_4	5 mg/L
Sodium	100 mg/L
Sulphate	250 mg/L
Sulphide	0.2 mg/L
Temperature	±2° of ambient
Total Coliform	<500 MPN/100 ml
Total Dissolved Solids (TDS)	1000 mg/L
Total Organic Carbon (TOC)	100 mg/L
Total Suspended Solids (TSS) (maximum monthly average)	50 mg/L
Total Suspended Solids (TSS) maximum daily average	<150mg/L

PARAMETER	TRADE EFFLUENT LIMIT
Trace Metals:	
Zinc	1.5 mg/L
Lead	0.1 mg/L
Cadmium	0.1 mg/L
Arsenic	0.5 mg/L
Chromium	1.0 mg/L
Copper	0.1 mg/L
Mercury	0.02 mg/L
Nickel	1.0 mg/L
Selenium	0.5 mg/L
Silver	0.1 mg/L
Tin	No standard
Total Heavy Metals	2.0 mg/L

3.2.3.2 Noise Abatement Act 1997

The Noise Abatement Act of 1997 was created in order to regulate noise caused by amplified sound and other specified equipment. This act has been said to address “some concerns but is too narrow in scope and relies on a subjective criterion” (McTavish). Given this, McTavish conducted a study to recommend wider and more objective criteria in accordance with international trends and standards but tailored to Jamaica's conditions and culture.

National standards outlined by the National Resources Conservation Authority (NRCA) used for noise levels are outlined in Table 3-9; values for commercial, industrial and residential areas are specified.

Table 3-9 NRCA standards for daytime and nighttime noise in various zones

ZONE	NEPA Daytime Guideline (dBA)	NEPA Nighttime Guideline (dBA)
Commercial	65	60
Industrial	75	70
Residential	55	50

3.2.3.3 The Natural Resources Conservation Authority (Air Quality) Regulations, 2006

Under section 38 of the NRCA Act, regulations pertaining to air quality in Jamaica are stipulated. The National standards, known as the National Ambient Air Quality Standards (NAAQS) are categorized into two groups. Part I of the NRCA Air Quality Regulations (2006) instructs on license requirements and indicates that every owner of a major or significant facility shall apply for an air pollutant discharge license. Part II makes reference to the stack emission targets, standards and guidelines.

According to the Natural Resources Conservation Authority (Air Quality) Regulations, 2006, a "significant air quality impact", means:

(a) the increment in the predicted average concentration of sulphur dioxide (SO_2), total suspended particulates (TSP), particulate matter less than ten microns (PM_{10}) or nitrogen dioxide (NO_2) is greater than an annual average of 20 µg/m³ or a 24-hour average concentration of 80 µg/m³; or

(b) the increment in the predicted average concentration of CO is greater than 500 µg/m³ as an 8-hour average or 2000 µg/m³ as a 1-hour average.

Table 3-10 summarizes the Significant Impact Concentrations and the Jamaican National Ambient Air Quality Standards (JNAAQS) and Guideline Concentrations (GC).

Table 3-10 Significant Impact Concentrations and the Jamaican National Ambient Air Quality Standards (JNAAQS) and Guideline Concentrations (GC) for air quality

Pollutant	Avg. Period	Significant Impact Concentration (µg/m³)	Jamaican NAAQS or GC (µg/m³)
PM_{10}	24-hr	80	150
	Annual	20	60
NO_2	1-hr	N/A	400
	24-hr	80	N/A
	Annual	20	100
SO_2	1-hr	N/A	700
	24-hr	80	280
	Annual	20	60
CO	1-hr	2000	40000
	8-hr	500	10000
1,3 Butadiene	1-hr	N/A	0.04

Pollutant	Avg. Period	Significant Impact Concentration (µg/m³)	Jamaican NAAQS or GC (µg/m³)
Acetaldehyde	1-hr	N/A	1250
	24-hr	N/A	500
Acrolein	1-hr	N/A	58.75
	24-hr	N/A	23.5
Benzene	Annual	N/A	1
Benzo (a) pyrene	1-hr	N/A	0.00275
	24-hr	N/A	0.0011
Carbon Tetrachloride	1-hr	N/A	6
	24-hr	N/A	2.4
Chloroform	1-hr	N/A	1250
	24-hr	N/A	500
Ethylene Dibromide	1-hr	N/A	7.5
	24-hr	N/A	3
Formaldehyde	1-hr	N/A	162.5
	24-hr	N/A	65
Methylene Chloride	1-hr	N/A	550
	24-hr	N/A	220
Styrene	1-hr	N/A	2500
	24-hr	N/A	1000
Xylenes	1-hr	N/A	5750
	24-hr	N/A	2300
Vinyl Chloride	24-hr	N/A	1
	Annual	N/A	0.2
Arsenic	1-hr	N/A	0.75
	24-hr	N/A	0.3
Beryllium	Annual	N/A	0.0013
Cadmium	1-hr	N/A	5
	24-hr	N/A	2
Chromium	1-hr	N/A	3.75
	24-hr	N/A	1.5
Cobalt	24-hr	N/A	0.12
Copper	1-hr	N/A	125
	24-hr	N/A	50
Lead	1-month	N/A	N/A
	3-month	N/A	2
Manganese	Annual	N/A	119
Mercury	1-hr	N/A	5
	24-hr	N/A	2
Nickel	1-hr	N/A	5
	24-hr	N/A	2
Selenium	24-hr	N/A	25
	Annual	N/A	10
Zinc	24-hr	N/A	12

In 1987, U.S. Environmental Protection Agency replaced TSP with PM_{10} as the indicator for both the annual and 24-hour health-related standards. The reason for this is because exposure to PM_{10} particles may cause serious health/respiratory related issues as these particles are retained deep in the lungs. The 24-hour NEPA standards for PM_{10} are shown in Table 3-10. However, the 24-hour US EPA standards are used for $PM_{2.5}$ and TSP:

- TSP = 150 µg/m³

- $PM_{2.5}$ = 35 µg/m^3

3.2.3.4 The Clean Air Act 1964

The Clean Air Act (1964) refers to premises on which there are industrial works, the operation of which is, in the opinion of an inspector, likely to result in the discharge of smoke, fumes, gases or dust in the air. An inspector may enter any affected premises to examine, make enquiries, conduct tests and take samples of any substance, smoke, fumes, gas or dust that may be considered necessary or proper for the performance of his/her duties.

3.2.3.5 Public Health Act 1985

The Public Health Act is administered by the Ministry of Health and Wellness through Local Boards, namely the parish councils. *The Public Health (Nuisance) Regulations 1995* aims to, control reduce or prevent air, soil and water pollution in all forms. Under the regulations:

- No individual or organisation is allowed to emit, deposit, issue or discharge into the environment from any source;
- Whoever is responsible for the accidental presence in the environment of any contaminant must advise the Environmental Control Division of the Ministry of Health and Environmental Control, without delay;
- Any person or organisation that conducts activities which release air contaminants such as dust and other particulates is required to institute measures to reduce or eliminate the presence of such contaminants; and
- No industrial waste should be discharged into any water body, which will result in the deterioration of the quality of the water.

3.2.3.6 The National Solid Waste Management Authority Act 2001

The National Solid Waste Management Authority Act of 2001 is “an act to provide for the regulation and management of solid waste; to establish a body to be called the National Solid Waste Management Authority and for matters connected therewith or incidental thereto”. The National Solid Waste Management Authority (NSWMA) was established in April 2002 as a result of this Act to effectively manage and regulate the collection and disposal of solid waste in Jamaica.

3.2.3.7 The Natural Resources (Hazardous Waste) (Control of Transboundary Movement) Regulations 2003

These regulations seek to implement the *Basel Convention on the Transboundary Movement of Hazardous Waste* and control transboundary movement and prevent the illegal trafficking of certain hazardous wastes. It is an offence to unlawfully dump or otherwise dispose of hazardous waste in areas under the jurisdiction of Jamaica. Waste resulting from the proposed project should be properly disposed of, and special attention should be paid to those considered hazardous under these regulations and as listed above.

3.3 REGIONAL AND INTERNATIONAL LEGISLATIVE AND REGULATORY CONSIDERATIONS

3.3.1 United Nations Convention on Biological Diversity

Signed by 150 government leaders at the 1992 Rio Earth Summit, the Convention on Biological Diversity (CBD) is committed to promoting sustainable development. The CBD is regarded as a means of translating the principles of Agenda 21 into reality and recognizes that "biological diversity is about more than plants, animals and microorganisms and their ecosystems – it is about people and our need for food security, medicines, fresh air and water, shelter, and a clean and healthy environment in which to live".

Jamaica became a party to the CBD on April 6, 1995. Jamaica's Green Paper Number 3/01, 'Towards a National Strategy and Action Plan on Biological Diversity in Jamaica', is evidence of Jamaica's continuing commitment to its obligations as a signatory to the Convention.

3.3.2 Convention on Wetlands of International Importance especially as Waterfowl Habitat, "Ramsar Convention" 1971

The Ramsar Convention is an intergovernmental treaty that focuses on maintaining ecological wetland systems and planning for sustainable use of their resources. It was adopted on 2 February 1971 in Ramsar, Iran. The mission of the Convention was adopted by the Parties in 1999 and revised in 2005 - "the conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world". Under Article 2.2 it is stated:

> Wetlands should be selected for the List on account of their international significance in terms of ecology, botany, zoology, limnology or hydrology" and indicates that "in the first instance, wetlands of international importance to waterfowl at any season should be included.

Jamaica became a contracting party on 7 February 1998 and has 4 sites covering a combined total of 37,847 hectares (378.47 km^2).

3.3.3 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

CITES generally seeks to protect endangered plants and animals and owing to the cross-boundary nature of animals and plants. This protection requires international cooperation. It aims to ensure that international trade of wild animal and plant species does not threaten the survival of the species in the wild, and it accords varying degrees of protection to over 35,000 species.

This convention was drafted in 1963 at a meeting of members of the International Union for Conservation of Nature (IUCN) and finalised in 1973. After being opened for signatures in 1973, CITES entered into force on 1 July 1975. Jamaica became a Party to CITES on June 22, 1997. In 2000, Jamaica enacted domestic legislation, the Endangered Species (Protection, Conservation and Regulation of Trade) Act, 2000 and Regulations to fulfil its obligations to CITES. The Management Authority for CITES in Jamaica is the Natural Resources Conservation Authority (NRCA). The Authority receives applications for permits and certificates to trade internationally in endangered species. The processing of applications is coordinated with the local Scientific Authority.

3.3.4 Cartagena Convention (Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region), 1983

Adopted in March 1983 in Cartagena, Colombia, the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, more commonly referred to as the Cartagena Convention, is the sole legally binding environmental treaty for the Wider Caribbean. The Convention came into force in October 1996 as a legal instrument for the implementation of the Caribbean Action Plan and represents a commitment by the participating countries to protect, develop and manage their common waters individually and jointly. The Convention is currently supported by three Protocols as follows:

- *The Protocol Concerning Co-operation in Combating Oil Spills in the Wider Caribbean Region* (The Oil Spills Protocol), which was adopted and entered into force at the same time as the Cartagena Convention;
- *The Protocol Concerning Specially Protected Areas and Wildlife in the Wider Caribbean Region* (The SPAW Protocol), which was adopted in two stages, the text in January 1990 and its Annexes in June 1991. The Protocol entered into force in 2000;
- *The Protocol Concerning Pollution from Land-based Sources and Activities in the Wider Caribbean Region* (LBS Protocol), which was adopted in October 1999.

3.3.5 United Nations Convention on the Law of the Sea (UNCLOS III) 1982

The United Nations Convention on the Law of the Sea (UNCLOS), also referred to as the Law of the Sea Convention and the Law of the Sea treaty, defines the rights and responsibilities of nations in their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources. UNCLOS III supersedes the Convention on the Territorial Sea and the Contiguous Zone (entered into force on 10 September 1964), as well as the Convention on the Continental Shelf (entered into force 10 June 1964), and both agreed upon at the first United Nations Convention on the Law of the Sea (UNCLOS I). Jamaica was the fourth country to ratify the UNCLOS III of 10 December 1982 on 21st March 1983. As of August 2013, 166 countries have joined in the Convention.

3.3.6 Convention on Fishing and Conservation of the Living Resources of the High Seas 1958

This convention considers that the development of modern techniques for the exploitation of the living resources of the sea has increased man's ability to meet the need of the world's expanding population for food and has exposed some of these resources to the danger of being over-exploited. It was done at Geneva on 29 April 1958.

3.3.7 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter

This instrument was adopted at the Inter-Governmental Conference on the Convention on the Dumping of Wastes at Sea, in London, United Kingdom in November 1972 and is commonly known as the London Convention. The London Convention, one of the first international conventions for the protection of the marine environment from human activities, came into force on 30 August 1975. Since 1977, it has been administered by the International Maritime Organization (IMO).

The London Convention prohibits the dumping of certain hazardous materials and specifies that a special permit is required prior to dumping of a number of identified materials and a general permit for other wastes or matter. In 1996, Parties adopted a Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 (known as the London Protocol) which entered into force in 2006. It is expected that this Protocol will eventually replace the 1972 Convention. It stressed a "precautionary approach" and introduces a different approach to regulate the use of the sea as a depository for waste materials. Article 4 outlines the prohibition of dumping wastes or other matter with the exception of those listed in Annex 1 of the document.

3.3.8 International Convention on Oil Pollution Preparedness, Response and Co-operation 1990

The International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC Convention) is an international maritime convention that sets measures for the preparation for and response to marine oil pollution incidents. The OPRC Convention was drafted within the framework of the International Maritime Organization (IMO) and entered into force in 1995. Jamaica is one of 107 parties to the convention (as of July 2013).

4.0 METHODOLOGY AND APPROACH

Methodologies for each section of the report are summarized below. Detailed methodologies can be seen in each respective sub-section of Section 6.0, Section 7.0 and Section 8.0.

4.1 TOPOGRAPHY

A topographic survey of the mangrove forest was conducted via theodolite survey. An Unmanned Aerial Vehicle (UAV) was used to collect data of the ground elevation of sections of the bay. The data was limited to only areas where there was a clearing in the mangrove forest.

4.2 SOILS

The soils map was adapted from Hanover Soil map, Price, R.W. (1960).

4.3 GEOLOGY

The geology map was adapted from the Mines and Geology Division Geological Map Series Sheet 1 and from Grippi (1978).

4.4 BATHYMETRY

Bathymetry data were collected from two sources for this project;

Bathymetric Surveys and Beach Profile: The Bathymetric survey was done using an echo-sounder and GPS device aboard a small boat. The Odom EchoTrac sounding device was mounted in an over-the-side configuration and was used to provide the water depth information. While the echo sounder recorded water depths, the Trimble RTK GPS simultaneously recorded spatial coordinates for each reading. As the boat traversed the nearshore area to create bathymetric tracks the measurements were automatically stored to a field computer. The measurements were converted to the national coordinate system and depths were referenced to mean sea level (MSL). The reduced depths and positions were then used to aid in the generation of contours for the nearshore of the project site. Using a theodolite, a total of 41 beach profiles were done along the shoreline of the property. The survey measures the depths to which a person could comfortably walk out to sea.

Satellite Derived Bathymetry: Data obtained from DHI was at a 90m x 90m spacing. This data set extended over 8km seaward of the site. More refined data was also collected from EOMAP that had bathymetric data in a 1x1m spacing. The collected bathymetric data was used to validate the EOMAP satellite data.

4.5 CURRENTS AND TIDES

Four (4) drogue tracks were done for the area. This involves placing a submerged floating device in the sea and tracking it with an onboard GPS. This is a measurement of the surface currents in the area. The drogues were deployed at four different locations within the cove.

4.6 WAVE CLIMATE

4.6.1 Model Validation

MIKE21, a coupled wave-hydrodynamic-sediment model developed by the Danish Hydraulic Institute, was set up for this project area. The model was used to transform wind and wave fields from deep water to the nearshore at the project site and to determine both operational wave conditions and hurricane wave conditions, including storm surge and inundation. Before beginning the numerical modelling, the first step is to validate its performance by comparing it to actual measurements in the field. The model was tested to see if it reflected the results obtained from the drogue tracking. We used the MIKE21 Transport module combined with the Wave (SW) and Hydrodynamic (HD) modules. This set-up shows what would happen to a dispersive pollutant introduced into the sea. The floats were treated as pollutants and introduced to the model at the same time it was deployed during the actual field investigation.

4.6.2 Offshore Wave Climate

The operational wave climate at the project site is characterized by (a) day-to-day, relatively calm conditions and (b) seasonal winter swells (December to May). The day-to-day conditions are created by the north-east Trade Winds. The north coast of Jamaica is especially vulnerable to these wave conditions because of its location. The swells, on the other hand, are generated by north Atlantic cold fronts and these waves can approach from the north to north-west sector.

The deep-water operational wave climate describing the day-to-day wave conditions was obtained from the global wave model Wave Watch 3 (WW3) developed by the US National Oceanic and Atmospheric Administration (NOAA). The WW3 model archives wave parameters including wave height, period and direction as well as the wind speed and direction. Data is available for every three hours from July 1999 to April 2015, giving a total of over 46,000 data points per parameter and covering almost 16 years. This time series of wave conditions was extracted for a node located north of Jamaica.

4.6.3 Nearshore Wave Climate

The nearshore wave climate for this project was developed using a spectral wave model MIKE21 SW to simulate waves as they approach the nearshore of the project site. The basic starting point of the model is the creation of a computational mesh where waves and currents are determined at each simulation time step. The MIKE21 model uses a flexible mesh that represents the seabed using a series of connected triangular and/or quadrangular elements. The bathymetric data is then interpolated on the flexible mesh to create the model domain. The validated model was used to investigate mean wave conditions within the bay. Twenty (20) years of wave data was used to predict the conditions at the site.

4.7 SHORELINE MORPHOLOGY

4.7.1 Historical Shoreline Analysis

A total of eight images were obtained spanning a 16-year period (2003 to 2017). The images were georeferenced, and the shorelines were digitized so as to inspect erosion and accretion trends. Six reference points at the back of the shoreline were used to measure the distance to shoreline. This provides an idea of the amount of fluctuation in beach width over the years.

4.7.2 Alongshore Sediment Transport

Using the mean annual wave climate, potential alongshore sediment transport was estimated for three profiles.

4.7.3 Beach Response to Swell Events

To assess the effects of the swell wave conditions at the site, it was necessary to evaluate the 18 years of offshore wave data. This was done by filtering the swell events from the wave dataset. A total of 76 swell events lasting more than two days were found in the wave database. The swell selected from the filtering was the one that had the highest wave heights and came from the NW and occurred from 1-10 March 2009.

4.8 WATER QUALITY

Water quality sampling exercises were conducted at twelve (12) stations on August 20th, September 19th and November 4th, 2019. Temperature, conductivity, salinity, dissolved oxygen, turbidity, Photosynthetically Active Radiation (PAR) – light irradiance, total dissolved solids and pH were collected using a Hydrolab DataSonde-5 water quality multi probe meter. Light extinction through the water column was calculated from PAR values recorded, however, due to extremely shallow depths (<0.5 m) at Stations 2, 3, 4, 6, 9, 10, 11 and 12, light extinction could not be calculated at these stations. Whole water samples were collected in pre-sterilized bottles, stored on ice and taken to Caribbean Environmental Testing and Monitoring Services Limited (CETMS Ltd.) for analysis of Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), nitrate, phosphate, faecal coliform and *Enterococcus*. Samples were also shipped to Test America Laboratories in Florida for analyses for Total Petroleum Hydrocarbons – Gasoline Range Organics (GRO C6-C10), Diesel Range Organics (DRO C10-C28) and Oil Range Organics (ORO C28-C35).

4.9 SEDIMENTOLOGY

4.9.1 Sieve Analysis

Five (5) sand samples were collected from the beach and sieve analysis conducted on each sample.

4.9.2 Hydraulic Probing

A water jet was used to probe the sea bottom at several locations along the shoreline and in the nearshore. This procedure determines the depth of silty or sandy material below the seabed. The probe is pushed into the seabed until it reaches hard/rocky material. The investigation informs areas that can be easily deepened and, in some cases, potential sources of sand. It also gives a preliminary indication of the kind of foundation possible for marine structures, especially for pilings.

4.9.3 Benthic Sediment Chemistry

Six (6) sediment samples were taken using a sediment grab sampler on September 19th, 2019 and analysed for the heavy metals (Pb - lead, As - Arsenic, Cd - Cadmium, Hg - Mercury) and Total Petroleum Hydrocarbons - Gasoline Range Organics (GRO C6-C10), Diesel Range Organics (DRO C10-C28) and Oil Range Organics (ORO C28-C35). The samples were stored on ice in a cooler and transported to Test America Pensacola Laboratory in Florida for analyses.

4.9.4 Marine Sedimentation Rate

Baseline sedimentation data were collected using sediment traps. A total of fifteen (15) sediment traps were deployed in and around the project area. The traps were retrieved after 28 days and its contents analysed to determine the rate of sedimentation (mg/cm^2/day) in the area. The sediment trap dimensions were approximately 21.4" (54.3 cm) long with an internal diameter of 3" (7.6 cm). Sediment traps were taken to the Caribbean Environmental Testing and Monitoring Services Limited for analysis.

The contents of the sediment traps were filtered through a filter paper, dried and then weighed. The results are represented in the form of "Mass of Sediment Recovered". Using the results retrieved from the laboratory, the sedimentation rate per day (mg/cm^2/day) was calculated by dividing the mass of sediment recovered by the number of days deployed and the area of the sediment trap opening.

4.10 AMBIENT NOISE

Noise level readings were taken from 7:00am Friday March 8th, 2019 to 7:00am Monday March 11th, 2019, by using a combination of Brüel & Kjaer noise analysers and Quest Technologies SoundPro DL Type 1 hand held sound level meters with real time frequency analyser setup in outdoor monitoring kits. The octave band analysis was conducted concurrently with the noise level measurements. Measurements were taken in the third octave which provided thirty-three (33) octave bands from 12.5 Hz to 20 kHz (low, medium and high frequency bands).

The noise meters were calibrated pre-and post-noise assessment by using a Brüel & Kjaer Type 4231 sound calibrator and a Quest QC - 10 sound calibrator. The meters were programmed to collect third octave, average sound level (Leq) over the period, Lmin (The lowest level measured during the assessment) and Lmax (The highest level measured during the assessment) every ten seconds.

Seven (7) noise meters with outdoor monitoring kits were set up. These meters were left for the entire seventy-two (72) hour assessment period in an outdoor measuring system and programmed to collect data every 10 seconds. A windscreen (sponge) was placed over the microphone to prevent measurement errors due to noise caused by wind blowing across the microphone. The microphone of the meters was at a height of approximately 1.5m above ground. There were no vertical reflecting surfaces within 3 m (10 feet) of the microphone. Noise statistics (L_{10} and L_{90}) were also calculated at each location.

4.11 AIR QUALITY

PM10 and PM2.5 particulate sampling exercises were conducted at the seven (7) locations (where noise monitoring was conducted) for 24 hours each on three (3) separate sampling occasions using Airmetrics Minivol Tactical Air Samplers. The PM10 sampling exercise was conducted from 12:00am – 12:00am on March 8th – 9th, August 9th – 10th and August 14th – 15th, 2019 whilst the PM2.5 sampling exercises were conducted from 12:00am – 12:00am on November 12th – 13th, November 13th – 14th and November 19th – 20th, 2019.

4.12 COASTAL AND BENTHIC ENVIRONMENT

4.12.1 Seagrass Community

The seagrass beds and other distinct communities (*Halimeda* bed) within and nearby the proposed project footprint were mapped and surveyed using a Trimble GEO XT 6000 series GPS. The beds were mapped by walking along the boundaries where possible (visibility as well as varying seagrass density made identifying clear boundaries difficult in some areas). Point Analysis were conducted within a grid pattern along the nearshore with 1.5m graduated Polyvinyl chloride (PVC) poles. Data collected at each probe point included; substrate composition (seagrass, sand, algae etc.), substrate type (pavement, mud, sand etc.) and general observations.

A total of eight (8), 0.25m^2 quadrats, divided into 10cm x 10cm grids, were placed randomly within the seagrass beds. Three of the quadrats were used at Bed 1, and five of the quadrats were used between Bed 2. The locations of each random quadrat were marked using a Trimble Geo-7x geographical positioning system (GPS) (Table 6-22) and a map developed using ArcGIS software. Shoot density, percentage cover, leaf blade length, overall health and appearance and other organisms located within the seagrass beds were all recorded. Where possible, seagrass blades were assessed within each quadrat. Shoot density was recorded within 5 random 10cmx10cm squares in each quadrat thrown. Percentage cover was recorded by counting the number of 10cmx10cm squares which contained seagrass. Leaf blade length was recorded by measuring 10 random lead blades within each quadrat thrown.

4.12.2 Reef Community

Eight (8) Permanent monitoring points were established, 4 of which were permanent transect line start point locations, along with 11 roving survey areas. A photo inventory, species list and general observations were recorded. Each transect line was 100 m long and run in a general E-W direction, parallel to the shoreline, maintaining a similar depth profile and avoiding large sand areas where possible. Photographs were taken every 5 meters using a 1 x 1 meter quadrat.

4.12.3 Fish and Invertebrate Community

Seaward fish and invertebrate surveys were conducted along each 100m-long transect line. The transect lines used the existing sediment traps as starting points, moving parallel to the shoreline. A cube (2 meters to the left, 2 meters to the right and 2 meters above the transect line) area was surveyed along the line for fish and a 4m wide belt transect was used for invertebrates, the total area surveyed for the fish and invertebrate transects were $800m^3$ and $400m^2$ respectively. Fish data was collected while swimming at a steady pace above the transect line and pausing for 1 minute every 2m. The invertebrate survey was then conducted in opposite direction, swimming along the belt transect. Data was recorded per species, total numbers and size class where possible. A photo inventory and general site observations such as; the presence of fish pots, nets, spear-fishermen, invasive and rare species were also recorded (if any).

Nearshore roving surveys were conducted within the project area and general observations were made.

4.13 MANGROVE COMMUNITY

The ecological survey of mangroves/wetland areas directly within the impact areas of the proposed hotel development was conducted over a four-day period; September 7 – 8 and September 14 – 15, 2019. To sample various forested areas of the property, data were collected from twenty-one (21) discrete belt transects at select locations on the property. The following data was collected within each transect:

- Standing water depth and salinity (middle of the transect)
- Visible fauna noted
- Mangrove tree species and numbers within sample area
- Mangrove tree heights (m) for up to 5 of each species present inside each transect
- Non-mangrove tree species presence, summarized in the DAFOR ranking
- Diameter at breast height (DBH) in cm, for up to 5 of each species present
- Density of mangrove seedlings within 1 m^2. This was conducted in a randomly selected patches within the sample area.

Additional data was collected by deploying water level data loggers at strategic locations. The water level loggers were secured on the substrate surface and recorded water temperature and pressure of water above the device (in PSI) in 15-minute intervals, which were converted into depth (cm). This provides evidence on the influence of water on the forest over a specified time.

4.14 TERRESTRIAL FAUNA

4.14.1 Avifauna

The Line transect method was utilised for the avian study due to the vast road network, footpaths and the uniformity of most of the vegetation throughout the property. This survey entailed walking along the roads/trails at a steady pace for a given distance while recording all bird species seen or heard ((Bibby, C., M. Jones, and S. Marsden. , 1998). The bird species were identified visually and by sound. The Ebird App by Cornell Lab was used to assist with the bird identification using its extensive library of bird species including pictures and audio for the Caribbean including Jamaica. The Cornell Lab Merlin App was also used to identify bird species in the field using photographs. The bird surveys were conducted in the day and night over 3 days and 2 nights. The DAFOR scale was used to measure abundance.

4.14.2 Herpetofauna

The herpetofauna assessment was conducted in areas adjacent to the roads/trails throughout the project area. The primary search points include trees, stone piles, bromeliads, small water bodies and other debris. All specimens seen were identified or pictures were taken for laboratory identification if necessary. Some specimens were captured for closer examination. These were placed in glass bottles or catchment containers but were subsequently returned to the habitat. Herpetofauna which could not be identified in the field were collected and identified using Amphibians and Reptiles of Caribbean Islands keys (Caribherp, 2015) and Amphibians and Reptiles of the West Indies (Henderson, 1988). The frogs were also identified by their calls as they usually become vocal at nights or after a rainfall event.

4.14.3 Insects

Daytime Survey

The insect assessment was conducted during daylight over a three-day period. Sampling was conducted primarily in the grassland and mangrove wetland. The possible hiding places for insects within the habitat were carefully searched. These included tree trunks leaves and dry wood. A sweep net was used to collect insects from the foliage and also flying insects. Most of the insects encountered in the field were identified on the spot; however, insects which could not be identified in the field were collected and identified using entomology collections at the University of the West Indies, Mona.

Nighttime Survey

Two Robinson's light traps (Plate 4-1), powered by portable generator, were deployed at sunset on January 18, 2020. Each trap was equipped with 160 watt mercury vapor insect collecting lamp. The insects collected were removed, stored in labelled containers and transported to the laboratory for identification at the University of the West Indies Mona. The University has an entomological collection of Jamaican Insects.

Plate 4-1 Robinson's light traps used in the insect survey

4.14.4 Bats

The bat survey was carried out in two phases.

Phase 1

All the possible bat roosts were identified on the property. This include caves, manmade structures and trees. The bat roosting areas and also the bat foraging areas were assessed. Of note bats which could be easily identified to species visually: (Jamaican Fig-eating Bat *Ariteus flavescens* roosting in trees) or by foraging activity (Fishing Bat, *Noctilio leporinus* foraging for fish over a waterbody).

The bat surveys were carried during both in the day and the night:

- In the day the tree canopies on selected trees on the property were assessed for the presence of the endemic Jamaican Fig-eating Bat (*Ariteus flavescens*). The survey was carried out along the sample points and trails used for the fauna assessment.
- In the night the bat survey was carried out along the trails used for the bird survey. This entailed walking along the road and noting the presence/absence bats.

Phase 2

The phase 2 survey was carried out using acoustics devices at the night. The Anabat Walkabout detector and the AudioMoth acoustic detectors were used to conduct the assessment over 1 night.

The Anabat Walkabout bat detector (Plate 4-2) is equipped with a broad-band microphone. The detector displays and saves the recordings in both full spectrum and zero crossings analysis (ZCA) to make them visible as sonograms (time vs frequency graphs). It is mainly used for active bat detecting. The recordings are of high resolution up to 500 kHz sample rate recordings.

Plate 4-2 Anabat Walkabout bat detector

AudioMoth device

The AudioMoth detector (Plate 4-3) is a full-spectrum acoustic logger, which can detect sounds ranging from audible to ultrasonic frequencies. It can record uncompressed audio to micro SD card from 8,000 to 384,000 samples per second. It is low-cost, small-sized and low-energy acoustic detector and is open-source and programmable, with diverse applications for recording animal calls or human activity at sample rates of up to 384 kHz.

Plate 4-3 AudioMoth bat detector

Line transect using the Anabat Walkabout Bat Detector

The main method used for the assessment was the line transect method. This entailed walking along the “transect” (road network on the property) and recording all the bat activity using the AnabatWalkabout detector. The AnabatWalkabout detector was configured to record audio files automatically, for 15 seconds once the device was triggered by a frequency as low as 8 kHz. The study was carried out from 6:10PM to 9:30PM.

Two AudioMoth detectors were configured to start recording from 17:30 PM to 06:00 AM over 1 night. The sample rate was 384 kHz and the gain was set at medium. The sleep duration was 3 minutes and the recording duration was for 1 minute.

Two AudioMoth acoustic detectors were deployed in areas where bat presence was noted in Phase 1 of the assessment.

4.14.5 Other Fauna

Other fauna observed on the project property during the assessment were noted and identified where possible. These included mammals, crustaceans and molluscs.

4.15 NATURAL HAZARDS

4.15.1 Hurricane Waves and Storm Surge

For the Atlantic Ocean, detailed information on tropical cyclones, including all hurricanes, has been collected by the US National Oceanic and Atmospheric Administration (NOAA), specifically at the National Hurricane Centre (NHC). This database of storm tracks and other parameters was the main source of information describing individual storms.

HurWAVE (Banton, 2002), an in-house hindcasting program, was used to determine the number, intensity and track of hurricanes and tropical storms have passed within a 300km radius of the Princess Resorts property since 1850.

Hurricanes have two immediate coastal hazards: (1) stronger waves and (2) higher water levels. These extreme conditions can be calculated using the MIKE21 Spectral Wave (SW)/Hydrodynamic (HD) models. The models can be forced with the highest deep-water wave and water level conditions and will simulate the transformation of waves from deep-water to the shallow water location of the site. For worst-case wave conditions, the values are selected through the process of hindcasting where conditions are calculated for a past event at a given time and location. Water levels are obtained by assessing the possible extreme tides and sea level rise conditions under hurricane conditions.

4.15.2 Inundation Levels

The numerical modelling presents wave run-up conditions for the existing shoreline. The storm surge calculated previously represents the static water level (+1.3 – 1.7m MSL) that will occur *close to* the shoreline. At the shoreline, however, waves run up onto the beach, which further increases the surge level. This component (wave run-up) is the dynamic component of storm surge that, when added to the static surge, gives the total inundation level.

The foregoing analyses provided the necessary design guidelines for the establishment of structure crest elevations and toe protection. These assessments were done in a two-step sequence (described below) by using the results from the sBEACH model as input to the online CRESS application.
sBEACH - The 1D sediment transport model and wave transformation model was used to model the cross-shore movement of sediments and expected shoreline changes (areas of high erosion or accretion potential) due to wave impact. The objective of using this model was to predict wave overtopping over any existing shoreline features along the project shoreline.

CRESS - The final inundation levels were computed by combining sBEACH results and the wave run-up/ overtopping over the existing shoreline features calculated from CRESS. CRESS is an online user interface that uses empirical coastal engineering equations. The application provides an approach to calculate wave run-up on either smooth-sloped linear beaches or rough sloped natural beaches, as well as wave runup and overtopping on rough and smooth sloped structures that are assumed to be impermeable.

Three representative cross-shore profiles were used as input to the sBEACH model. These profiles were extended perpendicularly from the shoreline to the 50m depth contour up to the project site. The wave heights and periods as well as the wind speeds and water level set-up from the 50-year storm event were extracted in 50m depths from the MIKE21 results, and input to the model with a direction perpendicular to the shore (representative of the worst-case scenario). Results were plotted for the 50- year return period after a typical 8-hour storm.

4.16 CULTURAL AND HERITAGE

4.16.1 Desk-Based Assessment

This is a thorough review of all the available written and graphic information relating to the area in order to identify the likely character, extent and relative quality of the actual or potential archaeological and architectural resources. It includes relevant historical documents, journals and books, aerial photographs and/or satellite imagery, maps and other contemporary data found in the nation's repositories such as the Island Record Office, National Archives, National Library of Jamaica, University of Technology (UTECH), University of the West Indies (UWI) and private collections. Web sites were also consulted.

Other sources included:

- Historical documentation including, maps, plans, estate accounts, correspondence, titles, deeds, just to list a few.
- Published and unpublished results of any previous archaeological work on the site or in its vicinity.
- Satellite images and aerial photographs.

4.16.2 Oral History

Oral history research was conducted in order to bridge the data gap that existed. Persons familiar with the site were interviewed and the information noted to add to the data base on the site.

4.16.3 Field Walk Surveys

A Transect Linear Field Walk survey was the archaeological technique employed to identify areas of pre-historic and/or historic activities and features. The site is divided into seven (7) Survey Zones and combed to identify areas of historical/archaeological interest. In areas of disturbed soil, such as uprooted trees and cuttings and crab holes, the soil profile was examined to ascertain the existence or non-existence of cultural stratigraphy below the surface.

4.17 TRAFFIC IMPACT ASSESSMENT

4.17.1 Road Condition Assessment

Pavement Condition Surveys are performed to give an indication of the physical conditions and serviceability of pavements in order to monitor and implement mitigative actions for deteriorated or failed pavement sections. These surveys are important to facilitate easily accessible and functioning road transportation networks. Pavement Condition Index (PCI) and International Roughness Index (IRI) are two non-destructive methods of evaluating pavement performance. The PCI involves a visual condition assessment to characterize distresses and the respective dimensions along the pavement surface. The TotalPave PCI Calculator application that was used allowed for information regarding types of distresses and their measurements to be inputted and logged to a cloud-based server in real-time. The logged distresses were then scored according to a standard procedure developed by the American Society of Testing Materials (ASTM). The IRI, initially developed in 1986, has been adapted to many different methods, all varying in advantages, however, one of the most accessible method is the use of an inertial profiler. This type of device uses accelerometers and sensors to detect changes in axes and correlate this to the road roughness condition. The TotalPave IRI collector used required a smartphone device and the TotalPave application designed to collect and process data. Raw acceleration, GPS and magnetometer information was then collected and logged from the smartphone while driving at a uniform speed. Once results were obtained for each respective survey, the data was compared to standard ratings to determine the extent of deterioration or the roughness thus ride quality of the pavement.

4.17.1.1 Pavement Condition Index (PCI)

Pavement Condition Index (PCI) is a convenient and non-destructive way to monitor the condition of pavement surfaces and to identify maintenance and rehabilitation needs. The PCI is a subjective method of evaluation based on observation and inspection of the distresses present on a pavement surface at specified intervals. It provides a numerical rating system (from 0-100) for the condition of road surfaces, with 0 being the worst possible condition and 100 the best. Pavement distresses are logged based on type, extent and severity. The survey is standardized by the American Society of Testing Materials and given the designation D6433[2].

Though the PCI does not measure structural capacity, roughness or skid resistance it does provide an objective, rational way to determine the maintenance and repair needs of roads. Continuous monitoring of PCI values allows for the establishment of a database that can be used to predict rate of deterioration and schedule maintenance accordingly. It can also be used to check the effectiveness of several road rehabilitation measures. The PCI Survey Application provided by TotalPave conforms to the American Society of Testing Materials Standard D6433 or the "Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys. The model requires the following inputs:

- Pavement Width
- Pavement Section Length
- Pavement Distress Type and Severity

The road survey of the sections of A1 within study area were logged in 17 m increments. Distresses were not recorded for the skipped intervals of 65 m. The PCI survey was done for 2 km of roadway including the intersections to be assessed and 500 m buffers north and south of the intersections.

4.17.1.2 International Roughness Index (IRI)

Pavement roughness is an expression of irregularities in the longitudinal profile of pavement surfaces that adversely affect the pavement ride quality for users. The rougher a pavement, the lesser the quality of the ride but conversely the smoother the pavement the better the ride quality. Roughness is typically monitored for all pavement management systems as it is a not only an indicator of the comfort

[2] ASTM International; "Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys"; December 2007

of motor vehicle trips but is proportional to vehicle delay, fuel consumption and vehicle maintenance costs. Developed by the World Bank in the 1980's, the International Roughness Index (IRI) is based on a ratio of a vehicle's accumulated suspension motion (vertical travel) in mm divided by the longitudinal distance travelled in km. This ratio called the Average Rectified Slope (ARS) is then multiplied by 1000 to give the IRI.

ARS = Accumulated Suspension Motion (mm)/Distance Travelled

*IRI = ARS * 1000*

Similar to the PCI, IRI readings were logged in 1km increments. In each increment two readings were taken for the IRI, one for each lane along the single carriageway. The two values were then averaged to give a roughness reading for that block in each increment. The IRI survey was done for 7 km of roadway in the study area.

4.17.2 Traffic Impact Statement

The approach involved meeting with the National Works Agency (NWA) and other relevant stakeholders to guide the assessment scope and methods. The methodology included the following:

1. Project inception meetings
    a. Meet with client to collect project information and details required.
    b. Meet with the NWA to discuss project parameters and assumptions that will be made to refine the scope of works required for approvals.
2. Desktop Data Collections
    a. NWA Road Network
3. Field Data Collection
    a. Conducting traffic counts between the hours of 6:00 AM and 6:00 PM over three days as per NWA specification at the agreed location.
    b. Field parameters to include:
        i. Signage and road markings
        ii. Lane and shoulder widths
        iii. Sight distance
        iv. Grade (slope of road)
4. Impact Analysis by using:
    a. The capacity analysis methodology published in the Highway Capacity Manual (HCM) 2000 edition. Sidra Intersection 8.0 traffic analysis software to analyse the intersections performance pre-development, during construction and post construction.

4.18 PUBLIC PERCEPTION SURVEY

The sample size was determined by using the Raosoft sample size calculator set at 95% confidence level based on the population within the SIA. Using this we determined the sample size by ratios in each Enumeration District (ED). Teams of persons then administered the required number (determined by the calculator at 95% confidence level) of questionnaires randomly within each ED.

During the period October 24, 25, 26, 28 and 30, 2019 a total of three hundred and twenty four (324) questionnaires were administered, of which three hundred (300) questionnaires were administered in the communities and twenty-four (24) questionnaires specifically targeting fishers were administered within a five-kilometre radius of the proposed site.

5.0 COMPREHENSIVE DESCRIPTION OF THE PROPOSED PROJECT

5.1 PROJECT FEATURES

The proposed project Master Plan is depicted in Figure 5-1.

5.1.1 Hotels

Princess Resorts will create a combination of four (4) separate hotel blocks and fourteen (14) overwater searooms. Each hotel will serve a different clientele, from adults only packages to family fun parks and public beach clubs.

The Resort's four hotels will be in the "5 STARS GRAND LUXURY" category and will be built in two phases. In each phase, there will be two hotels that share the service area, making the plot ratio of the land and its environmental impact much lower, because operationally they will work as a single hotel. This means that for each phase (2 hotels) there will be one centralized kitchen, one industrial area, one warehouse area, one personnel area etc. In each phase, one of the two hotels will be "Adults Only", with the objective of differentiating and diversifying the product.

The Resort, with a total of 2,037 rooms can be broken down as follows:

PHASE I **1,012 Hotel Rooms**

HOTEL I. 422 Rooms

HOTEL II. 590 Rooms

PHASE II **1.025 Hotel Rooms**

HOTEL III. 590 Rooms

HOTEL IV 435 Rooms

With this number, category and type of hotels the density is lowered, making it more sustainable, exclusive and luxurious. The service and common areas will be concentrated in three levels to reduce the amount of land area used for construction.

The facades of the buildings will be porches that will cause these to merge with the outside creating spaces of natural and ecological ventilation. The hotels will have all the rooms with sea views.

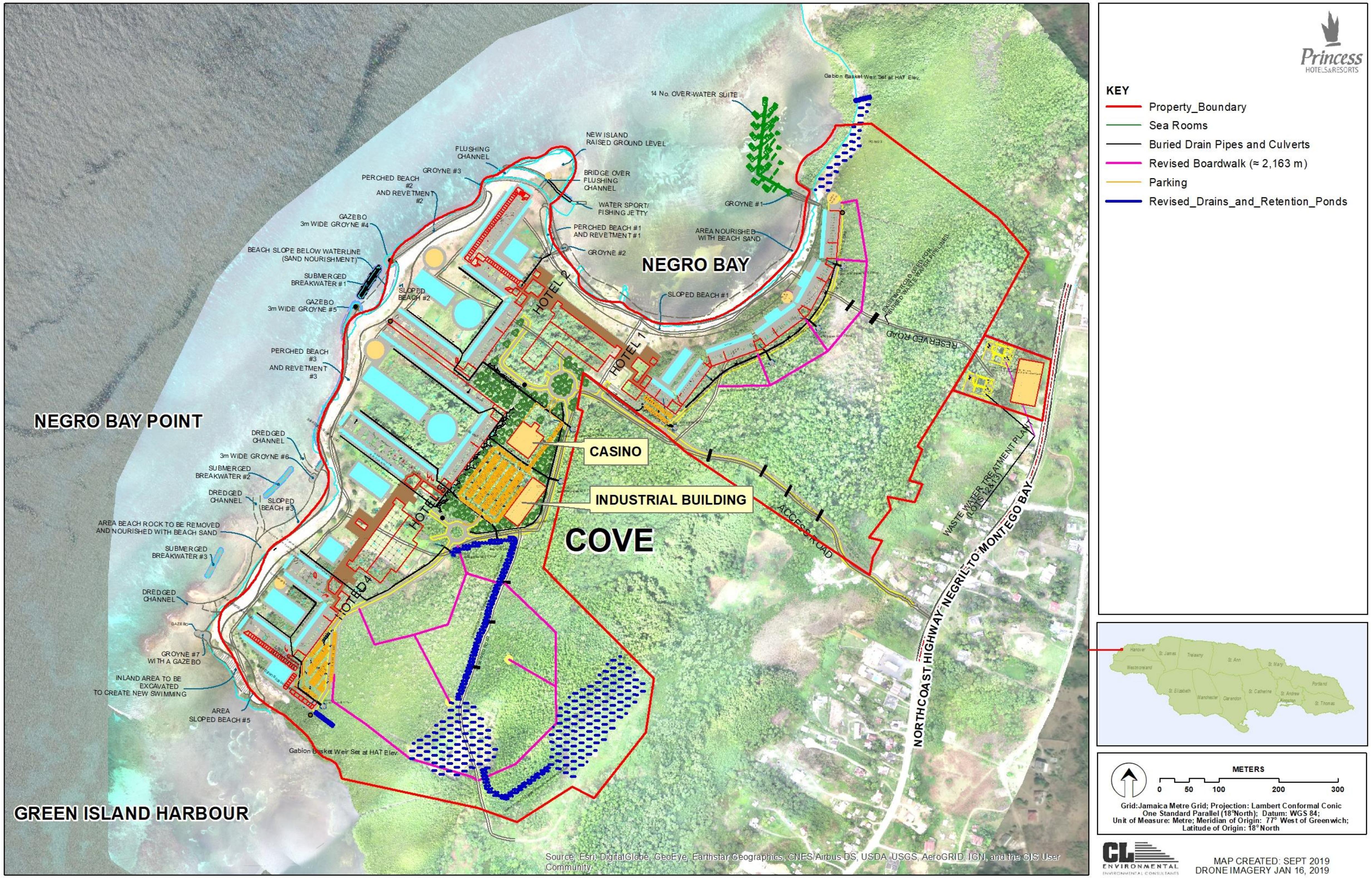


Figure 5-1 Proposed Princess Hotel Master Plan

This Resort will be, without a doubt, an example of integration with the environment and an economic engine for the creation of employment in the area, since being a luxury resort will contribute significantly to the development of the area.

5.1.1.1 Description of Hotel I and II

The two hotels of the first phase are located along the bay in the shape of a half-moon (northeastern side of the Property).

HOTEL I

Hotel I is located in the East Zone of the Bay in the form of a half moon. It is a hotel designed for Adults Only. It will consist of 6 buildings of rooms. Each building has a ground floor plus 3 levels. All rooms have a sea view and are of simple bay (room and corridor).

On the ground floor all the rooms will have a garden and direct access to the pool, approximately 25 percent of them will have direct access to the pool. Three facades will have the rooms in the shape of a fish spike to guarantee direct views of the sea.

All rooms will be of the Junior Suite type with Bath Suite. That is, with bedroom and lounge area in the same space, and bathroom with separate toilet with couples' shower and bathtub integrated into the bedroom, with the possibility of giving privacy to the bathroom.

The rooms next to the connection cores will be superior rooms, 40 units. There will also be 4 Suites and 14 rooms/cabin on the sea ("Sea Rooms").

The facades of these blocks will be horizontal, without visible columns, eliminated visual barriers to have the best view of the sea. The railings will be glass and will give a light appearance to the building. The terraces will be in semi-cantilever. Most rooms can enjoy the sunset.

Every two buildings we will have an office of common service per plant, which will facilitate the operation. The common areas are developed in three levels that connect directly with the buildings of rooms, facilitating the traffic of the clients and employees.

On the access floor there will be a three-way lobby engine that facilitates the circulations, two will be covered. The first impression will be spectacular because there be a view of the bay from the lobby.

All circulations will be open galleries that will be ventilated naturally with cross ventilation. The height of the common areas will be 4.50 m, which will facilitate ventilation and ensure that a minimum height of 4.00m can be guaranteed in the airconditioned spaces.

The structure of the common areas will respond to the 10 x10 m grid, facilitating its prefabricated construction.

The Reception will be located to the right of the entrance, next to a commercial gallery that is required to go to the rooms. The whole building is parallel to the beach and the sand will be up to the edge of the building. A large porch will be the transition between the beach and the Main Buffet Restaurant.

The pool bar with its restaurant in the form of a gazebo will make this plant a real balcony of 130m above the sea.

On the second floor through another large porch access to specialty restaurants, all overlooking the sea, and a game room, a nightclub and convention area; all spaces intended for Adults Only.

On the third floor, which corresponds to the same level of the third floor of rooms, we have the GYM, the SPA, and the Adult Platinum Area with private restaurant, lounge and infinity pool with private solarium. This level is the most exclusive of the hotel and the one with the best views.

The service areas are developed in the three levels plus a basement where part of the parking lot and general stores are located. A central kitchen of the HOTEL I and II supplies all the kitchens of the hotel's completions, facilitating the operation thereby optimizing the of construction area and facilitating operations.

The hotel will have 7 swimming pools distributed throughout all the room buildings, parallel to the beach. In this way overcrowding will be avoided and the guest will be able to find private spaces throughout the complex.

Table 5-1 shows the types and number of rooms at Hotel I.

Table 5-1 Types and number of Rooms at Hotel I

HOTEL 1 (Adults)

JUNIOR SUITE A		84
JUNIOR SUITE A - Swim Up Pool		252
JUNIOR SUITE B		14
JUNIOR SUITE B - Swim Up Pool		42
JUNIOR SUITE C		1
JUNIOR SUITE C - Swim Up Pool		3
JUNIOR SUITE D		1
JUNIOR SUITE D - Swim Up Pool		3
SUITE A		4
SUITE B		4
SEA ROOM		14
TOTAL		422

HOTEL II

Hotel II is located in the West Zone of the Bay in the form of half moon, and in the north coast of the land. It consists of 4 buildings of rooms. Each building has a ground floor plus 3 levels. All the rooms have a view to the sea and are two of simple bay (room and corridor) and two of double bay, with interior corridor.

On the ground floor all the rooms will have a garden and direct access to the pool, approximately 25 percent of them will have direct access to the pool. Three facades will have the rooms in the shape of a fish spike to guarantee direct views of the sea.

All rooms will be of the Junior Suite type with Bath Suite. That is, with bedroom and lounge area in the same space, and bathroom with separate toilet with couples' shower and bathtub integrated into the bedroom, with the possibility of giving privacy to the bathroom.

The central façade of the building will hold the Suites. These will be staggered with suites. There will be 16 suites. The facades of these blocks will be horizontal, without visible columns, eliminated visual barriers to have the best view of the sea. The railings will be glass and will give a light appearance to the building. The terraces will be in semi-cantilever.

Every two buildings we will have an office of common service per plant, which will facilitate the operation.

The common areas are developed in three levels that connect directly with the buildings of rooms, facilitating the circulations covered of the clients and of the service.

On the access floor there will be a three-way lobby engine that facilitates the circulations, two will be covered. The first impression will be spectacular since we will have a view of the bay. All circulations will be open galleries that will be ventilated naturally with cross ventilation. The height of the common areas will be 4.50 m, which will facilitate ventilation and ensure that a minimum height of 4.00m can be guaranteed in the airconditioned spaces.

The structure of the common areas will respond to the 10x10 m grid, facilitating its prefabricated construction.

The Reception will be located to the left of the entrance, next to a commercial gallery, which is required to go to the rooms.

The whole building is parallel to the beach and the sand will reach it. A large porch will be the transition between the beach and the Buffet restaurant. The pool bar with its restaurant in the shape of a viewpoint will make this plant a real balcony of 140 m above the sea. On the second floor, through another large porch, we access specialty restaurants, all overlooking the sea, a Sport Bar and a Kids Club. Spaces for families. On the third floor, which corresponds to the same level of the third floor of rooms, we have the GYM and the Platinum Area with private restaurant, lounge and infinity pool with private solarium. This level is the most exclusive of the hotel and the one with the best views.

The service areas are developed in the three levels plus a basement where part of the parking lot and general stores are located. A central kitchen of the HOTEL I and II supplies all the kitchens of the hotel's completions, facilitating the operation thereby optimizing the of construction area and facilitating operations.

The hotel will have 9 swimming pools distributed in all the buildings of rooms, parallel to the beach. In this way overcrowding will be avoided and the guest will be able to find private spaces throughout the complex. One of the pools will be a water park for children.

Table 5-1 shows the types and number of rooms at Hotel II.

Table 5-2 Types and number of Rooms at Hotel II

HOTEL 2 (Families)

STANDARD ROOM A		198
STANDARD ROOM A - Swim Up Pool		70
STANDARD ROOM B		216
STANDARD ROOM B - Swim Up Pool		75
JUNIOR SUITE A		6
JUNIOR SUITE A - Swim Up Pool		2
JUNIOR SUITE B		12
JUNIOR SUITE B - Swim Up Pool		3
JUNIOR SUITE C		3
JUNIOR SUITE C - Swim Up Pool		1
SUITE A		3
SUITE A - Swim Up Pool		1
TOTAL		590

5.1.1.2 Description of Hotel III and IV

HOTEL III

Hotel II is located in the West Zone of the coast. It consists of 3 buildings of rooms. **Each building has a ground floor plus 3 levels.** All the rooms have a view to the sea and are two of simple bay (room and corridor) and one of double bay, with interior corridor.

On the ground floor all the rooms will have a garden and direct access to the pool, approximately 25 percent of them will have direct access to the pool. Three facades will have the rooms in the shape of a fish spike to guarantee direct views of the sea.

All rooms will be of the Junior Suite type with Bath Suite. That is, with bedroom and lounge area in the same space, and bathroom with separate toilet with couples' shower and bathtub integrated into the bedroom, with the possibility of giving privacy to the bathroom. The central façade of the building will hold the Suites. These will be staggered with suites. There will be 12 suites.

The facades of these blocks will be horizontal, without visible columns, eliminated visual barriers to have the best view of the sea. The railings will be glass and will give a light appearance to the building. The terraces will be in semi-cantilever. There will be two common service offices per plant, which will facilitate the operation.

The common areas are developed in three levels that connect directly with the buildings of rooms, facilitating the circulations covered of the clients and of the service. In the access floor we have a three-way lobby engine that facilitates the circulations, two will be covered. The first impression will be spectacular since we will have a view of the bay.

All circulations will be open galleries that will be ventilated naturally with cross ventilation. The height of the common areas will be 4.50 m, which will facilitate ventilation and ensure that a minimum height of 4.00m can be guaranteed in the airconditioned spaces. The sunsets will be spectacular from all the main building.

The structure of the common areas will respond to the 10x10 m grid, facilitating its prefabricated construction.

The Reception will be located to the right of the entrance, next to a commercial gallery that is required to go to the rooms. The whole building is parallel to the beach and the sand will be up to the edge of the building. A large porch will be the transition between the beach and the Buffet restaurant. The pool bar with its restaurant in the form of a viewpoint will make this floor a real balcony of 90 m above sea level.

On the second floor, through another large porch, there will be access to the specialty restaurants, all overlooking the sea, a Sport Bar and a Kids Club. Spaces for families. On the third floor, which corresponds to the same level of the third floor of rooms, there will be the GYM and the Platinum Area with private restaurant, lounge and infinity pool with private solarium. This level is the most exclusive of the hotel and the one with the best views.

The service areas are developed in the three levels plus a basement where part of the parking lot and general stores are located. A central kitchen of the HOTEL I and II supplies all the kitchens of the hotel's completions, facilitating the operation thereby optimizing the of construction area and facilitating operations.

The hotel will have 7 swimming pools distributed throughout all the buildings of rooms, parallel to the beach. In this way overcrowding will be avoided and the guest will be able to find private spaces throughout the complex. One of the pools will be a water park for children.

Table 5-3 shows the types and number of rooms at Hotel III.

Table 5-3 Types and number of Rooms at Hotel III

HOTEL 3

STANDARD ROOM A	342
STANDARD ROOM A - Swim Up Pool	120
STANDARD ROOM B	-
STANDARD ROOM B - Swim Up Pool	-
JUNIOR SUITE A	-
JUNIOR SUITE A - Swim Up Pool	-
JUNIOR SUITE B	87
JUNIOR SUITE B - Swim Up Pool	29
SUITE A	9
SUITE A - Swim Up Pool	3
SUITE B	-
SUITE B - Swim Up Pool	-
SUITE C	-
SEA ROOM	-
TOTAL	590

HOTEL IV

Hotel IV is located in the West and South Zone of the coast. It is a hotel designed for adults only. It consists of 4 buildings of rooms. Each building has a ground floor plus 3 levels. All the rooms have an ocean view, one with a simple bay (room and corridor) and two with a double bay with rooms on both sides and a central corridor. On the ground floor all the rooms will have a garden and direct access to the pool, approximately a quarter of the total. All rooms will be of the Junior Suite type with Bath Suite. That is, with bedroom and lounge area in the same space, and bathroom with separate toilet with couples' shower and bathtub integrated into the bedroom, with the possibility of giving privacy to the bathroom. There will be 21 suites.

The facades of these blocks will be horizontal, without visible columns, eliminated visual barriers to have the best view of the sea. The railings will be glass and will give a light appearance to the building. The terraces will be in semi-cantilever. Every two buildings we will have an office of common service per plant, which will facilitate the operation.

The common areas are developed in three levels that connect directly with the buildings of rooms, facilitating the circulations covered of the clients and of the service. On the access floor there will be a three-way lobby engine that facilitates the circulation, two will be covered. The first impression will be spectacular since we will have a view of the bay.

All circulations will be open galleries that will be ventilated naturally with cross ventilation. The height of the common areas will be 4.50 m, which will facilitate ventilation and ensure that a minimum height of 4.00m can be guaranteed in the heated spaces.

The structure of the common areas will respond to the 10x10 m grid, facilitating its prefabricated construction.

The Reception will be located to the left of the entrance, next to a commercial gallery, which is required to go to the rooms. The whole building is parallel to the beach and the coast. A large porch will be the transition between the beach and the Buffet restaurant. The pool bar with its restaurant in the shape of a viewpoint will make this floor a real balcony of 90 m above the sea. The sunsets will be seen from the whole building.

On the second floor, through another large porch, there will be access to the specialty restaurants, all overlooking the sea, and a casino, a nightclub and convention area. Spaces for Adults.

On the third level that corresponds to the same level of the third floor of rooms, there will be the GYM, the SPA, and the Adult Platinum Area with private restaurant, lounge and infinity pool with private solarium. This level is the most exclusive of the hotel and the one with the best views.

The service areas are developed in the three levels plus a basement where part of the parking lot and general stores are located. A central kitchen of the HOTEL I and II supplies all the kitchens of the hotel's completions, facilitating the operation thereby optimizing the of construction area and facilitating operations.

The hotel will have 8 swimming pools distributed around all the buildings of rooms, parallel to the beach. In this way, overcrowding will be avoided, and the client will be able to find private spaces throughout the complex.

Table 5-4 shows the types and number of rooms at Hotel IV.

Table 5-4 Types and number of Rooms at Hotel IV

HOTEL 4 (Adults)

STANDARD ROOM A	132
STANDARD ROOM A - Swim Up Pool	50
STANDARD ROOM B	117
STANDARD ROOM B - Swim Up Pool	31
JUNIOR SUITE A	3
JUNIOR SUITE A - Swim Up Pool	1
JUNIOR SUITE B	60
JUNIOR SUITE B - Swim Up Pool	20
SUITE A	12
SUITE A - Swim Up Pool	4
SUITE B	-
SUITE B - Swim Up Pool	-
SUITE C	5
SEA ROOM	-
TOTAL	435

5.1.2 The Casino

The casino is designed as an independent building inside the Resort, separated from the hotels, with its own access and vehicle parking area.

The casino building will be of two floors and will have a double-lane Lobby Motor and a very contemporary and ecological façade based on green walls that integrate perfectly with the Protected Area that surrounds it. On the ground floor there will be the casino reception and play area which will be approximately 2,000m^2, with toilets, a bar and an administration area.

On the first floor there will be a restaurant and a VIP area of about 700m^2 with a terrace and garden where there will be the Sky Bar and porch for the restaurant.

5.1.3 Searooms

Fourteen (14) searooms will be built to the eastern end of the property. Figure 5-2 shows a plan view and cross sections of the overwater sea rooms.

All electrical, telecommunication, plumbing/water, wastewater, gas, air conditioning and fire protection related utilities will be routed under the boardwalk in watertight piping. These utilities will be supplied from the main Hotel property (Figure 5-3, Figure 5-4, Figure 5-5).

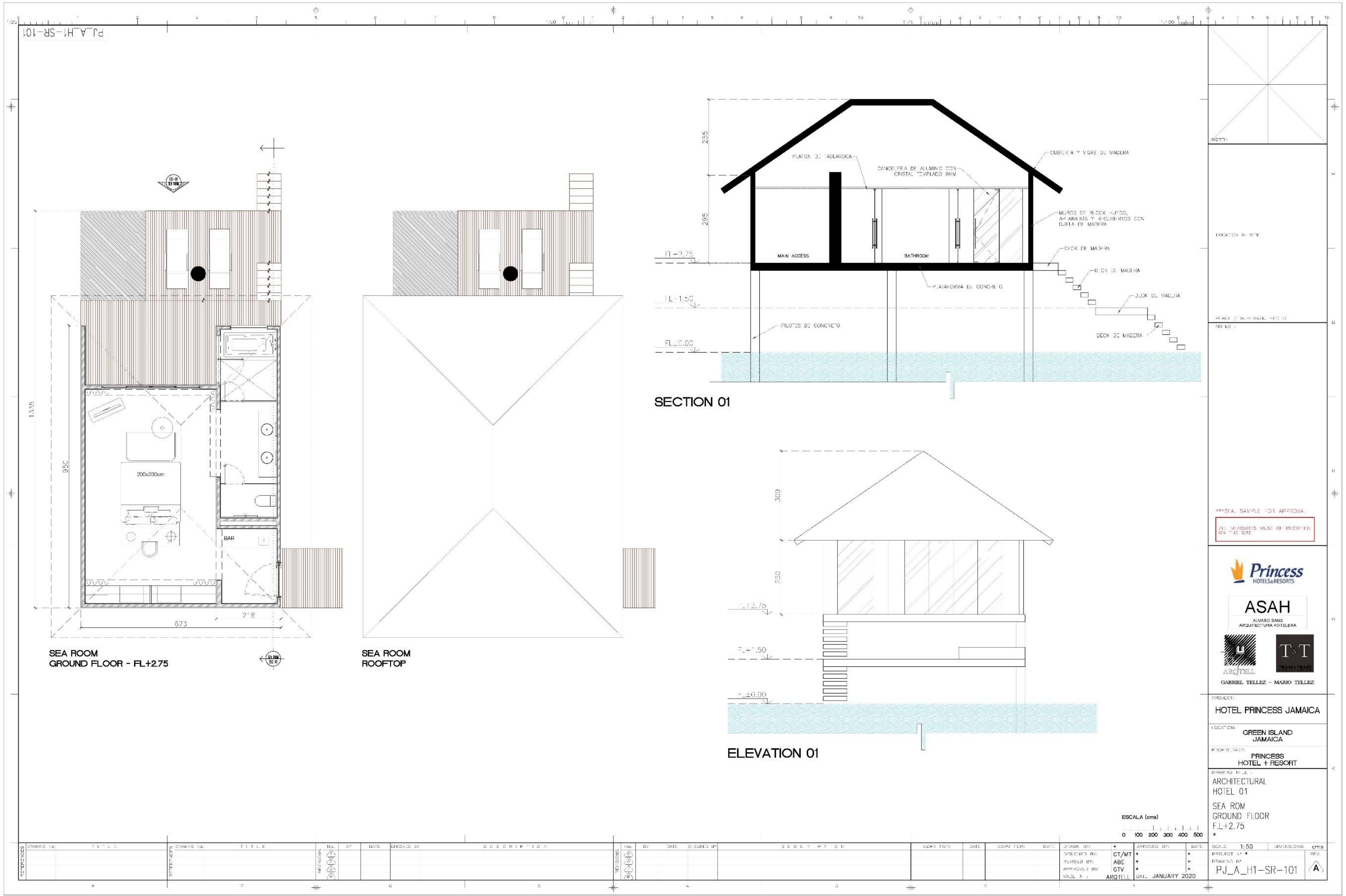


Figure 5-2 Plan View and Cross Sections of the Overwater Sea Rooms

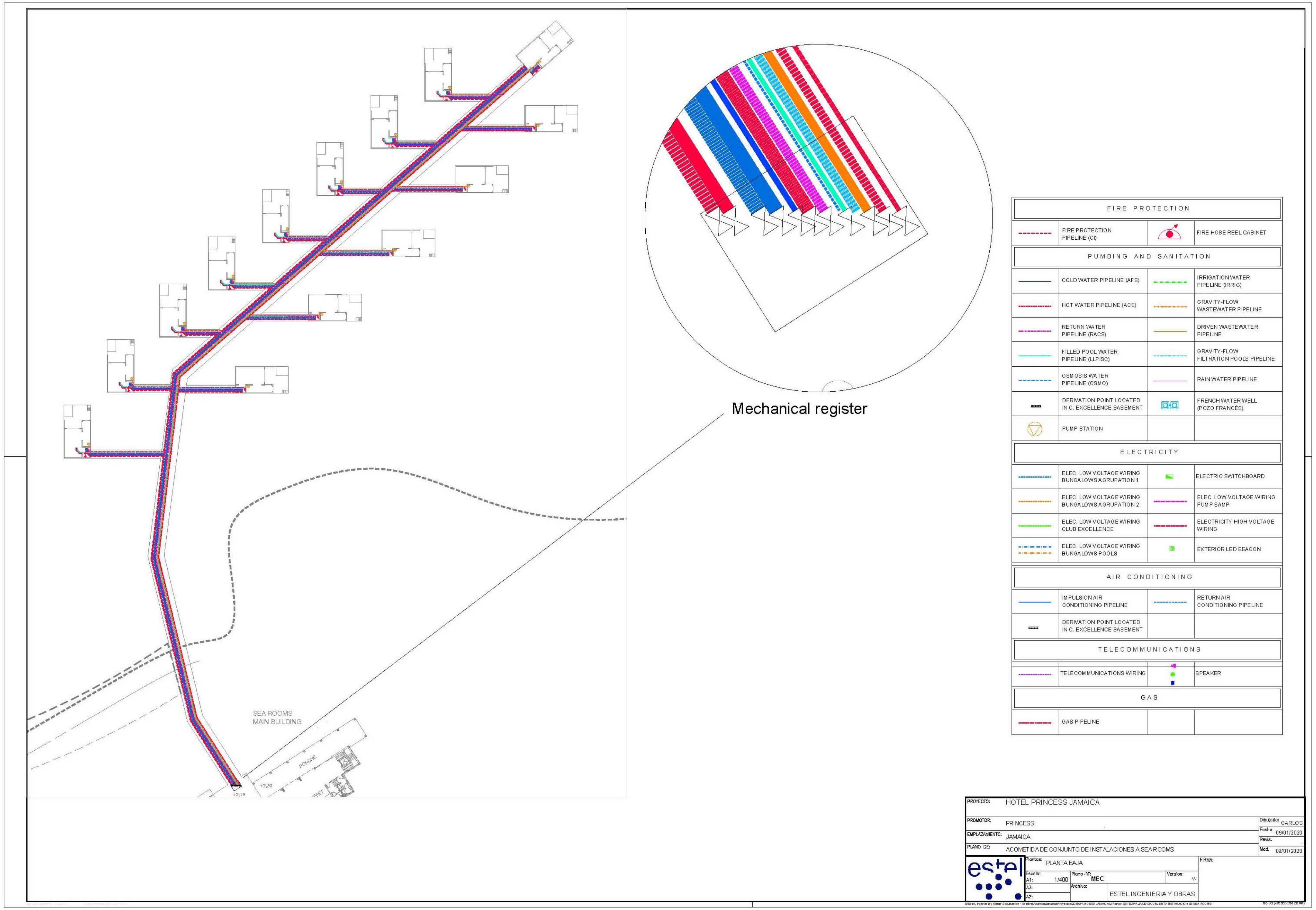


Figure 5-3 Drawing showing utilities (plumbing, wastewater, gas, air conditioning, fire protection) positioning underneath the boardwalk

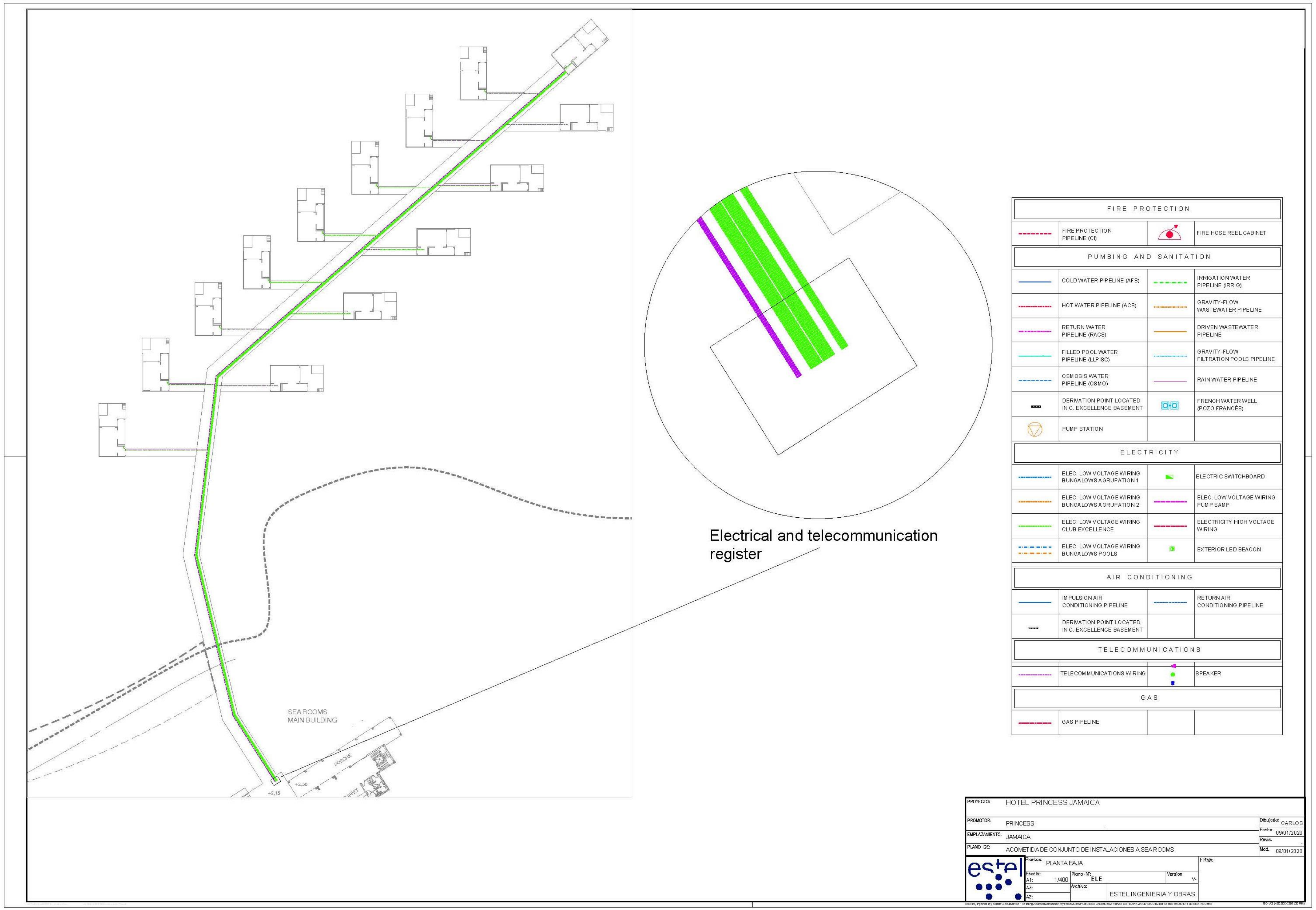


Figure 5-4 Drawing showing utilities (electrical and telecommunications) positioning underneath the boardwalk

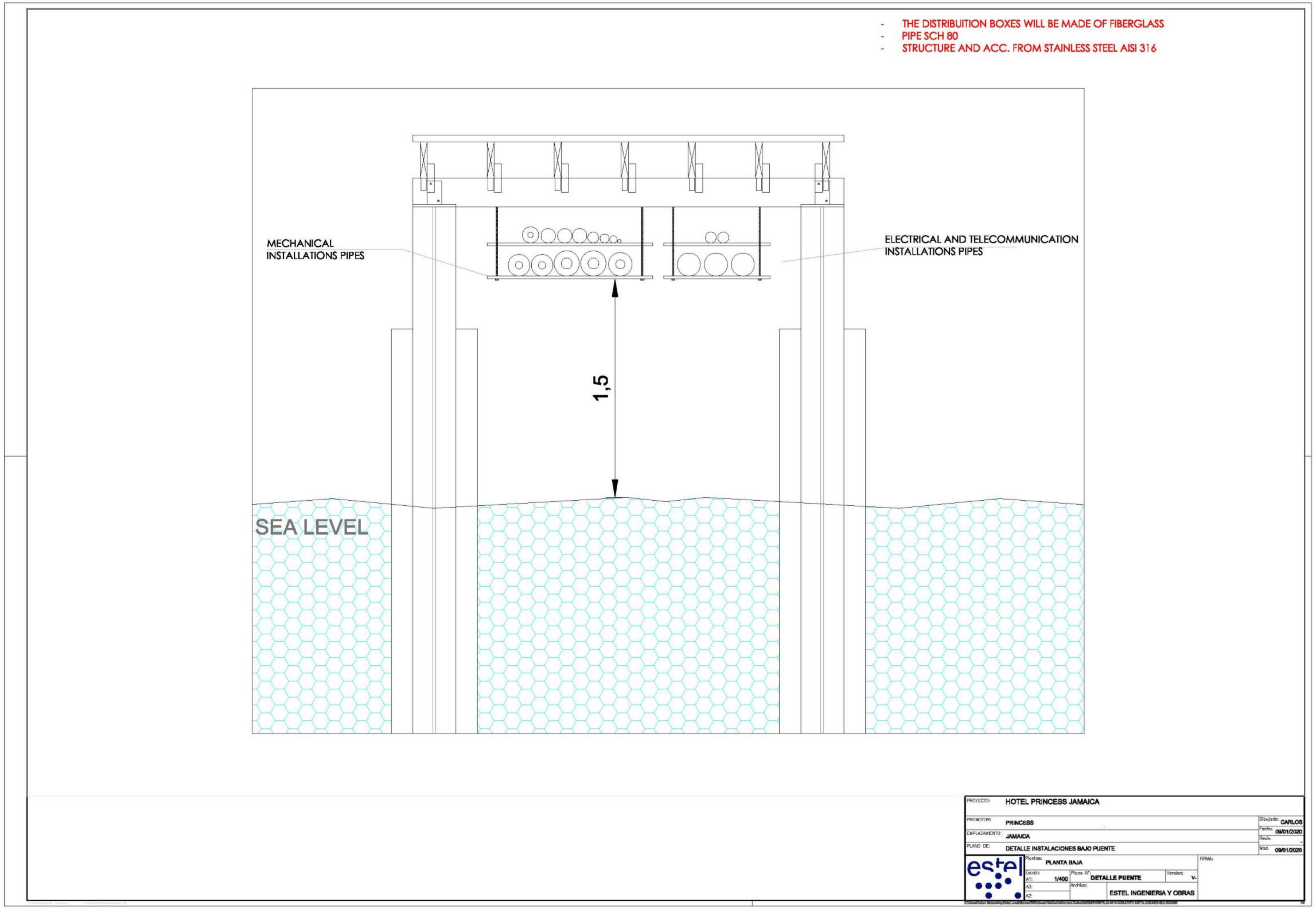


Figure 5-5 Cross Section drawing showing all utilities positioning underneath the boardwalk

5.2 AUXILIARY PROJECT ACTIVITIES

5.2.1 Back of House

The Back of House is located between Hotel 1 and Hotel 2. It will house an office area, maintenance facilities, laundry, main kitchen, food storage areas, break rooms for employees, employee dining room, employee bathrooms, central air-condition room, loading docks and rubbish/garbage storage and removal area.

The laundry area will operate for 16 hours per day utilizing two shifts of 8 hours each seven days per week. Equipment will include washing machines, dryers, steamers, air compressor, stain remover, press machines and ironing tables.

Figure 5-6 shows the location of the Back of House.

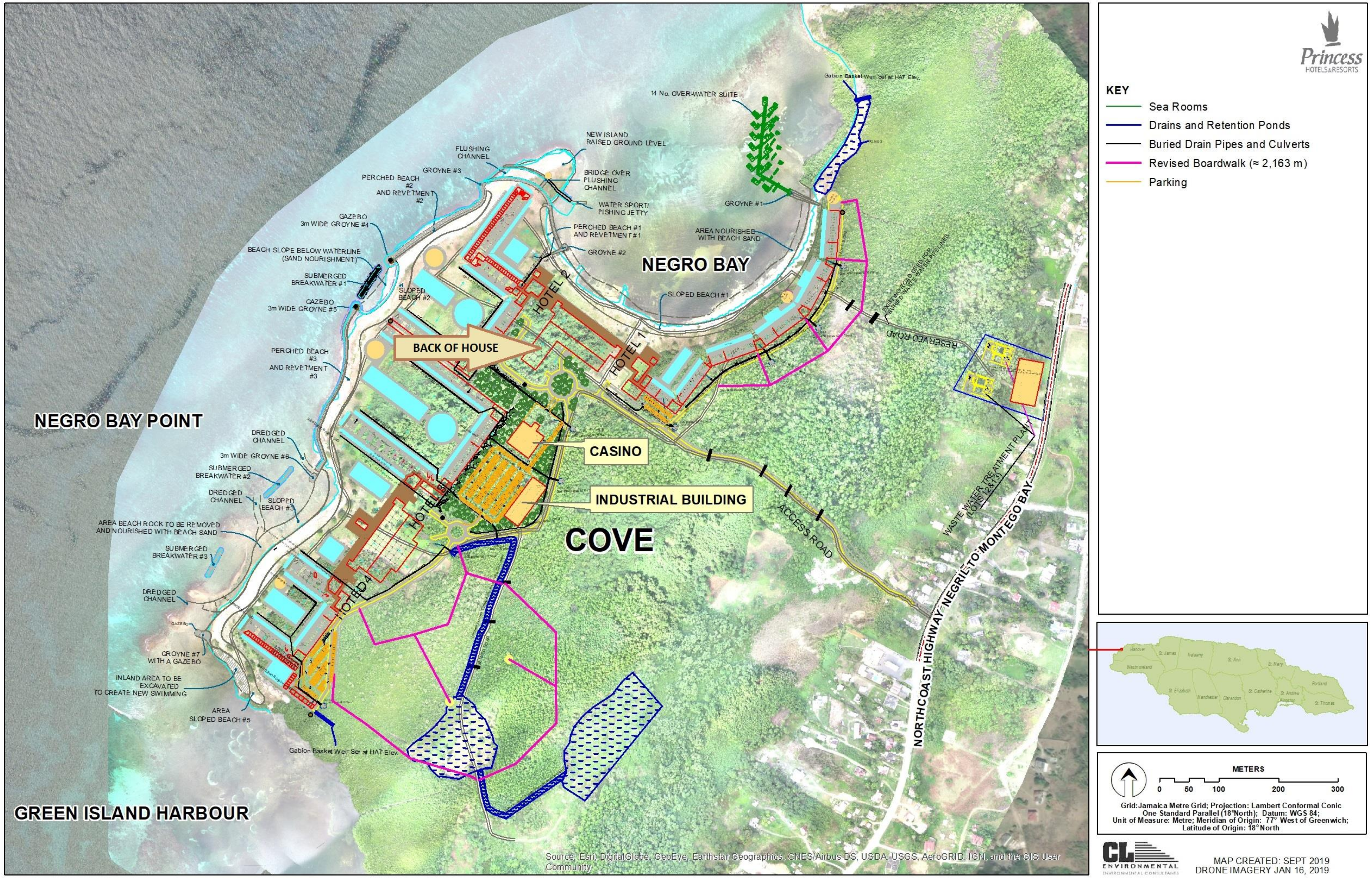


Figure 5-6 Map showing location of Back of House

5.2.2 Storm Water Drainage and Hydrology

Figure 5-1 and Figure 5-7 show the drainage master plan layout while Figure 5-8 to Figure 5-11 shows enlarged drainage plans for each hotel section (Hotel 1, 2, 3 and 4). The concept allows the proposed site to drain freely into the mangrove forest and maintain its natural drainage pattern. This will be done by a series of buried pipes (0.45 – 0.6m diameters), covered box drains (1m wide x 0.45 m deep) and culverts to maintain hydrologic flows between areas separated by roads or dykes (Smith Warner International Limited, 2019). The retention pond areas will be reforested with mangroves as per the request of NEPA to rehabilitate two mangrove areas.

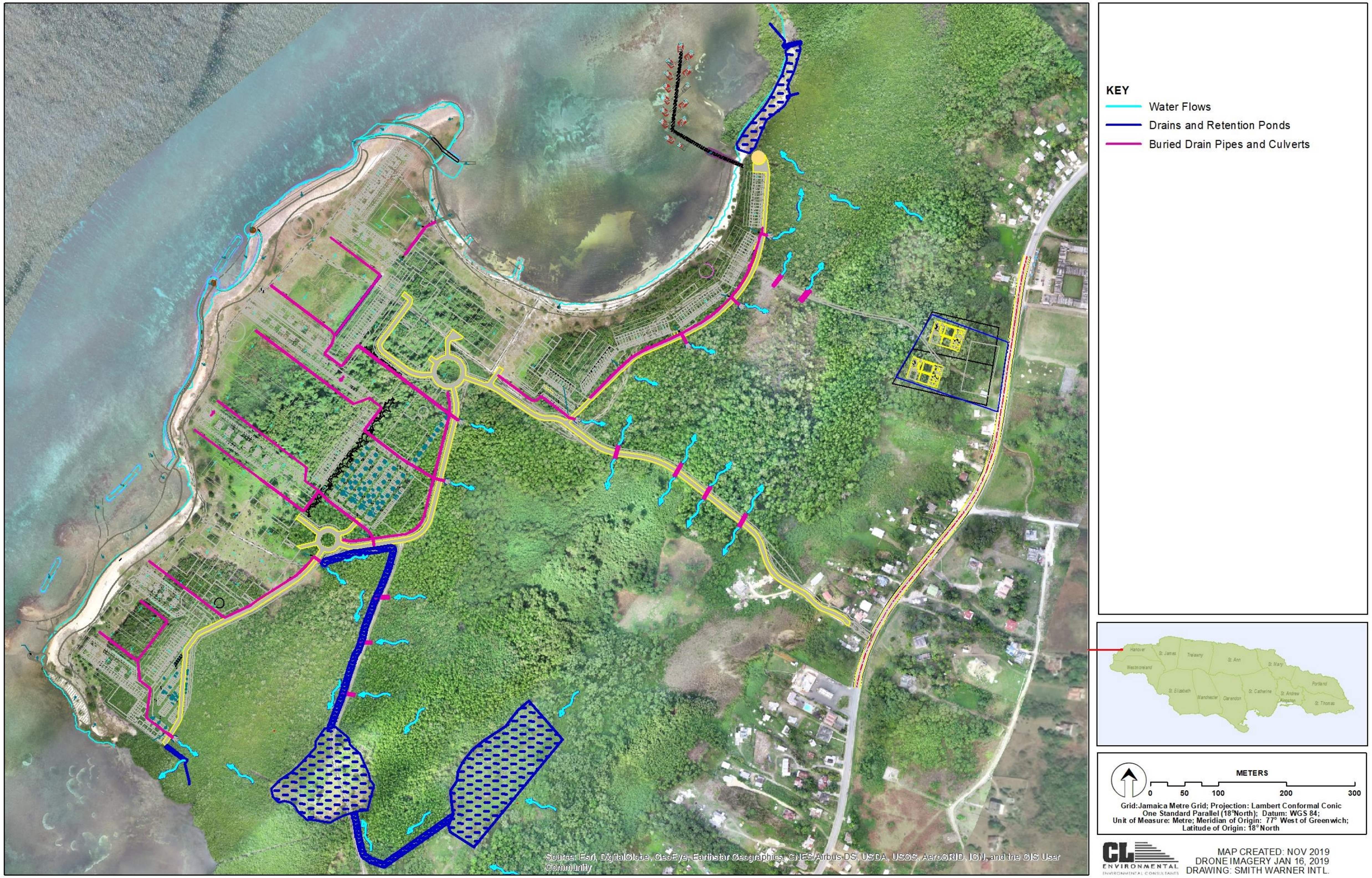


Figure 5-7 Proposed Drainage features and water flows

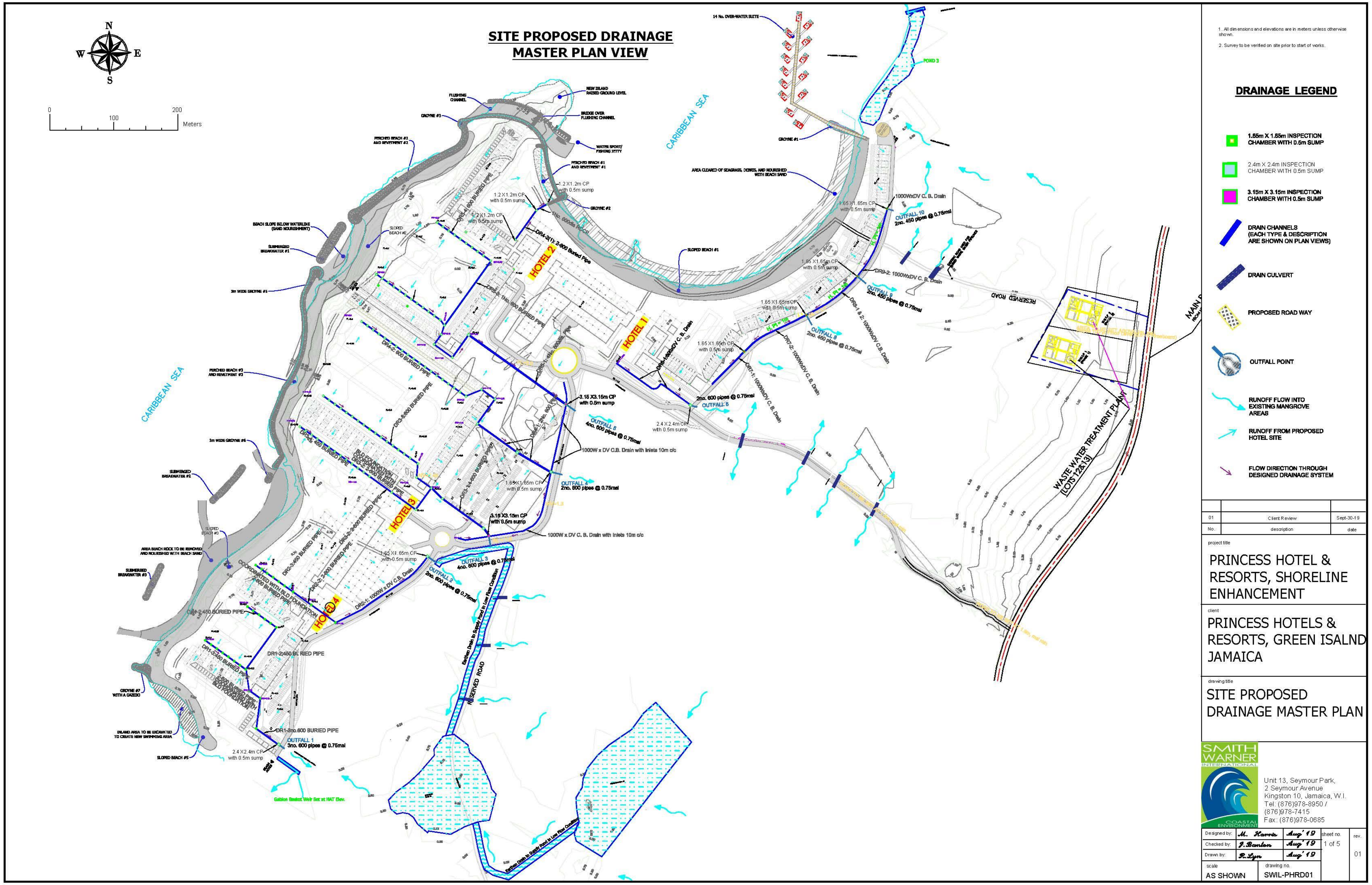


Figure 5-8 Master Drainage Plan Layout

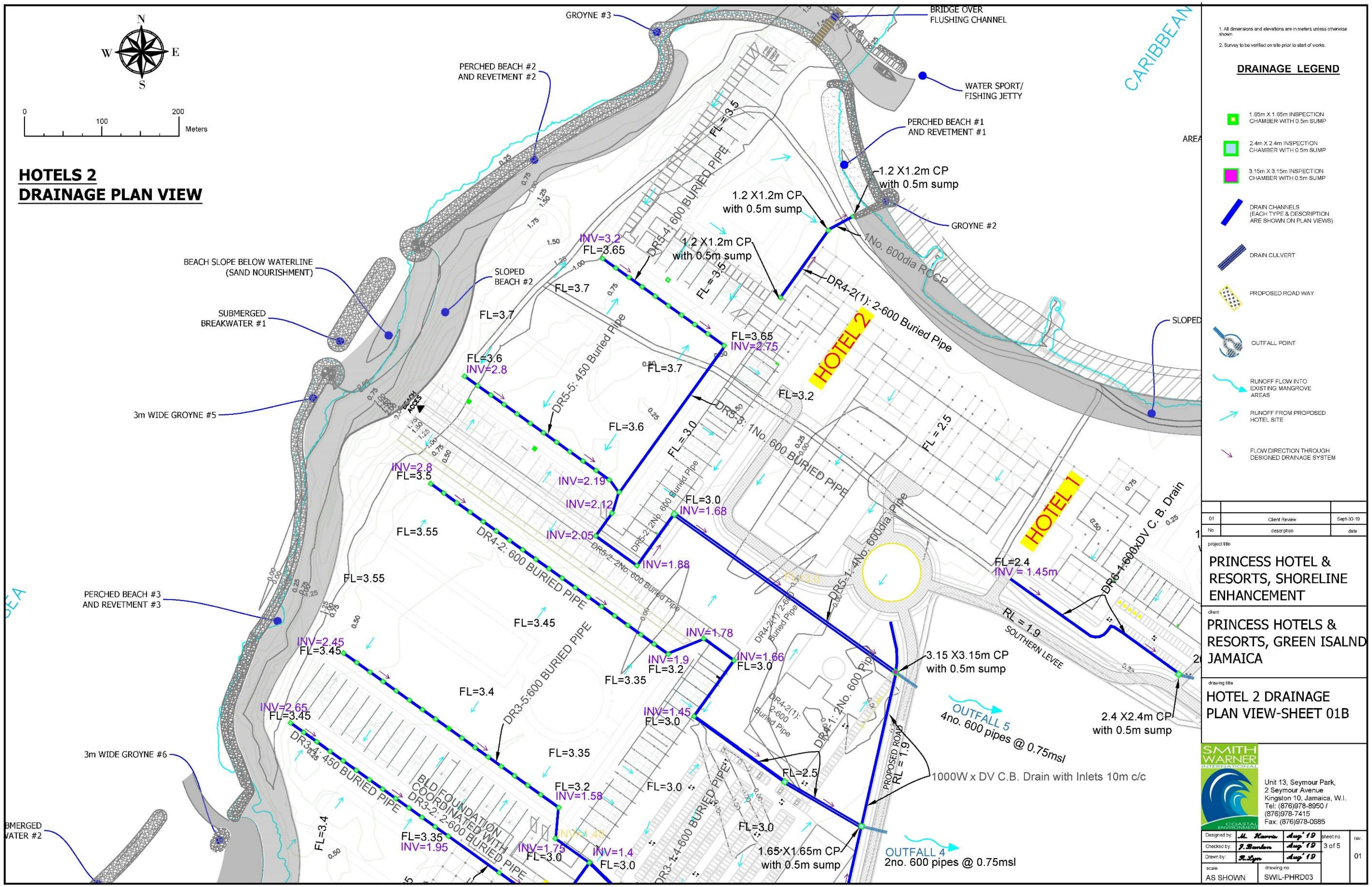


Figure 5-9 Hotel 1 Drainage Plan Layout

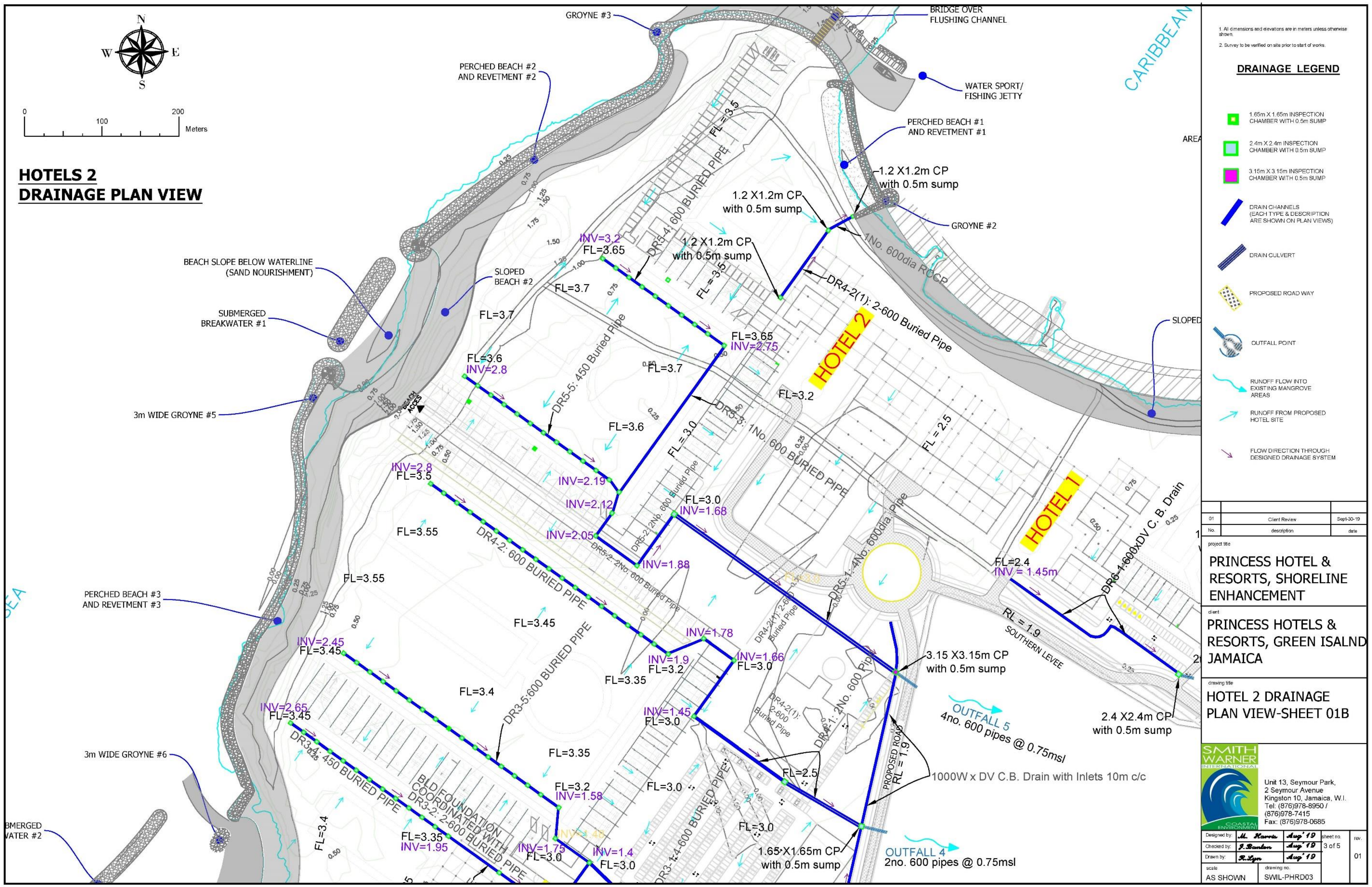


Figure 5-10 Hotel 2 Drainage Plan Layout

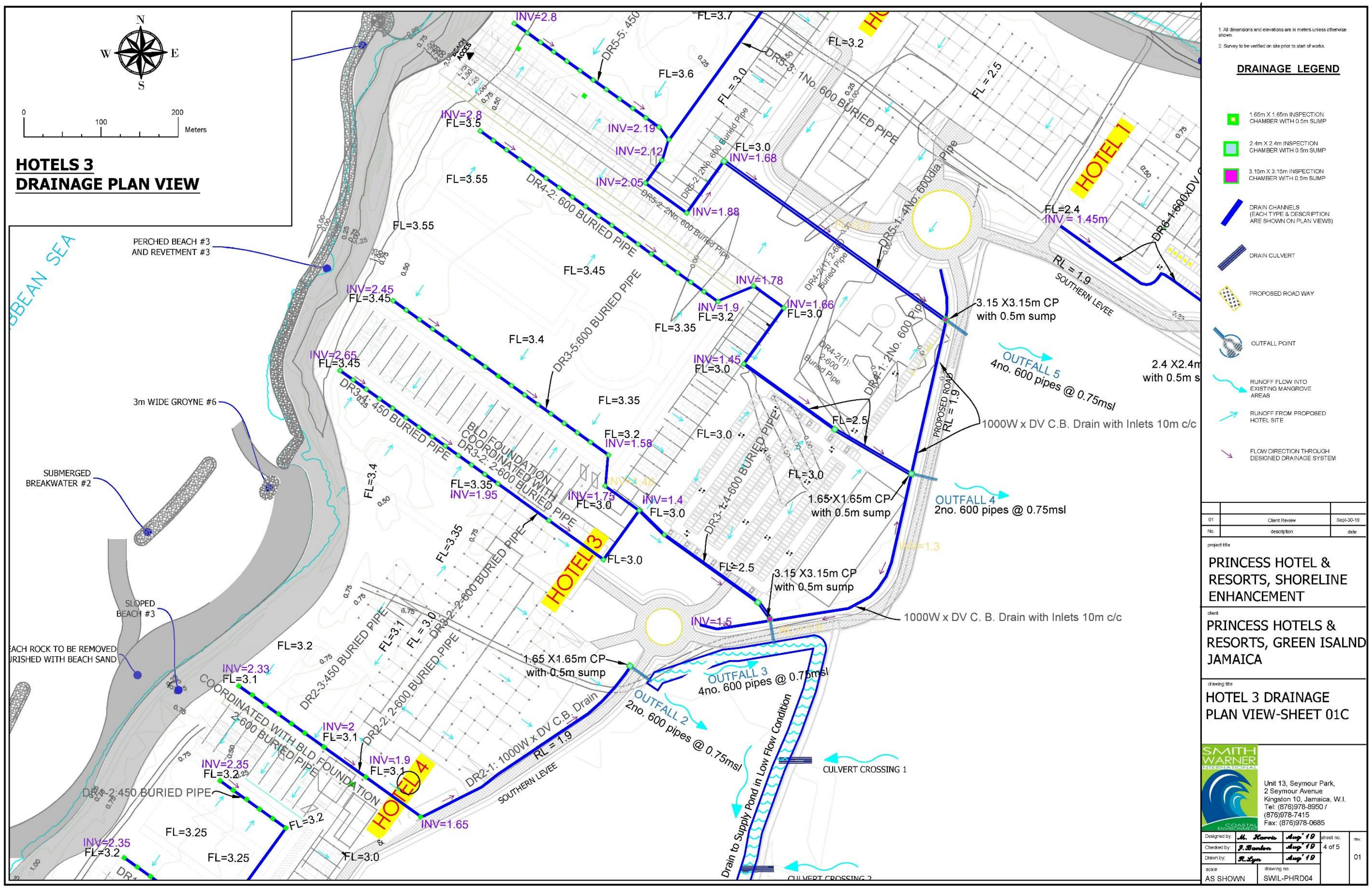


Figure 5-11 Hotel 3 Drainage Plan Layout

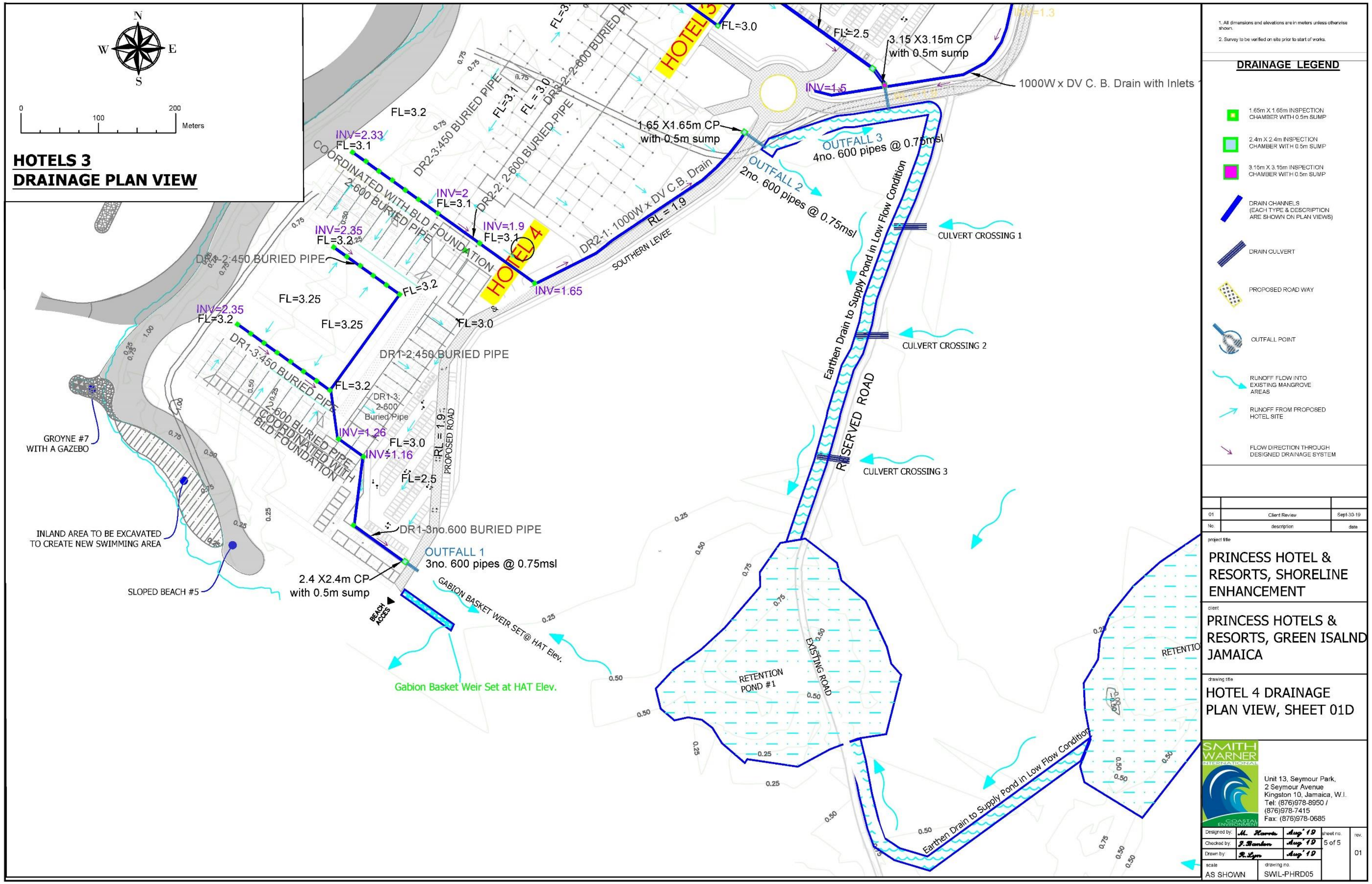


Figure 5-12 Drainage Plan Layout

5.2.3 Electricity Supply

Electricity supply will be obtained from the Jamaica Public Service Company Limited. The electricity demand for the resort when completed (2 Phases) is estimated at 3,444,926.47 KWhr/month (3,500 MWh/month).

The Jamaica Public Service Company has said it has the necessary reserves to provide the electricity supply to the resort.

5.2.4 Potable Water

Potable water for the development will be sourced from the National Water Commission (NWC). Water consumption is estimated to be 90,138.57m^3/month (≈ 23,812,091 US gal/month). This equates to approximately 3,005 m^3/day (≈ 800,000 US gal/day).

Checks with the NWC have indicated that they are in a position to provide the water needed for the resort. The water will be sourced from the Logwood water system.

5.2.5 Water Storage

A tank will be built at the Platinum Jamaica Princess Hotel to meet the needs of drinking water and firefighting. According to our studies and previous experiences; a 1.5 m^3/day/room, is required to fully meet the needs of the rooms and common areas such as restaurants, kitchens, amenity areas, etc.

The water reserve (tank storage) will be 3 times the demand for the total 2037 Rooms (Phase 1 of 1012 Rooms and Phase 2 of 1025 Rooms).

The tank will be used for: (i) production process; (ii) human use in the event of an emergency; (iii) fire extinguishing purposes. The fire pump extraction points are installed at different heights to ensure its exclusive use for fire extinguishing purposes and, moreover, this system allows use of the total tank capacity in case of fire. In case of fire, the system ensures the necessary flow rate supply for a minimum of 30 minutes (Level of Risk=Medium).

Tank capacity = Calculated to store 3 times daily demand + firefighting

The tanks will be compartmentalized internally dividing the phases of the project, and in turn the tanks of each phase will be divided into one for untreated water and another for water treated by osmosis.

- 1st Phase Tank = (1.5m^3/Room/day x 1012 Rooms x 3) + 240m^3 = 4,794 m^3
- 2nd Phase Tank = (1.5m^3/Room/day x 1025 Rooms x 3) + 240m^3 = 4,852.5 m^3

The location of the water tank will be on the first level of the industrial building attached to the central car park of the complex (Figure 5-13).

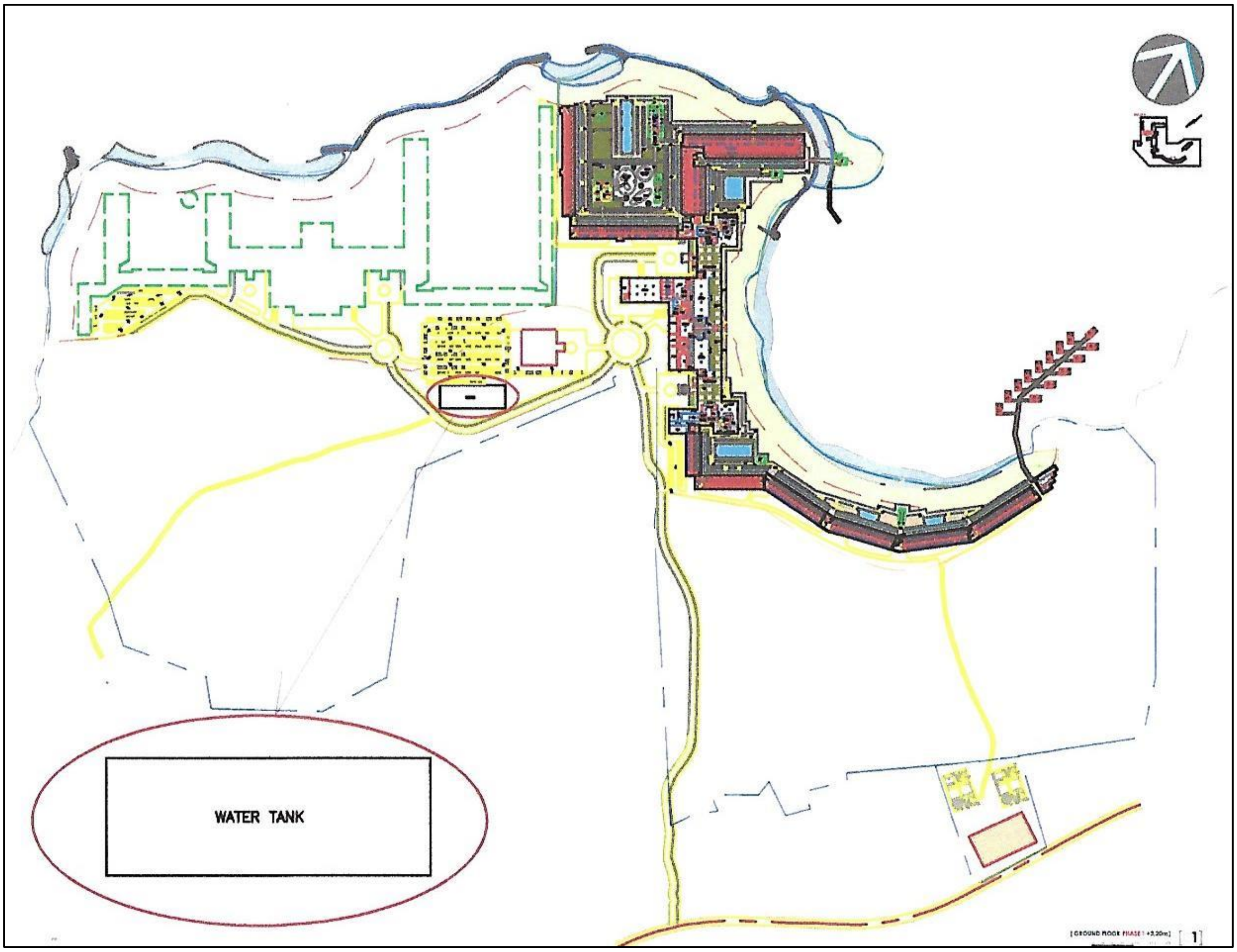


Figure 5-13 Location of the water tank at the Industrial Building

5.2.6 Industrial Building

In addition to the water storage tank, the Industrial Building will house the hotels central air conditioning system.

5.2.7 Wastewater Treatment Plant

The wastewater treatment plant will be located on Lots 12 & 13. These plots have direct access from the main road, which allows quick and safe access to the plant by waste removal trucks.

A network of buried pipes will collect the wastewater from each hotel block or building which will lead to the main collection point which will be connected directly to the Treatment Plants. The complex will have several pumping stations interspersed in the buried network.

Given the global average norm for hotels in the Caribbean, guest water consumption is 1,000 litres (1 m^3) per day. During the first phase of the hotel (1,012 rooms with an average occupancy of 2 guests per day) potable water consumption would be 2,000 m^3/day.

Consequently, with a return flow rate of 80% between the water produced and the water to be treated, we can estimate the needs of the WWTP of the hotel of **1,600 m^3/ day.**

Later and after the hotel extension in a second phase of 1,025 rooms, another 2x1,025 m3/day freshwater RO Plant is considered, therefore the WWTP should also be doubled to treat **3,200 m^3/day.**

The wastewater treatment system will reuse the 80% of this water for irrigation. Additionally, it is planned to send the 20% of the effluent to an infiltration well.

The design flow rate for the plant will be 175 m^3/h at peak flow and 66 m^3/h at average flow. The estimated floor area of the WWTP is 45m x 28m.

5.2.7.1 Influent Water Chemistry

The characteristics of the influent is expected to be similar to the urban residuals, which are of domestic origin. In addition, due to the restaurants on the hotel property, the influent is likely to have high oil and fat loads. Table 5-5 shows estimated influent chemistry.

Table 5-5 Estimated influent water chemistry

Parameters	Units	Value
BOD5	mg/l	400
COD	mg/l	1,000
TSS	mg/l	200
Nitrate	mg/l	50
Phosphate	mg/l	10
Fats, Oils and Grease	mg/l	150
pH	pH Units	7 +/- 0.5
Faecal Coliform	MPN/100ml	1.00 E+08

5.2.7.2 Treated Effluent Water Chemistry

Treated effluent may possibly be used for irrigation and should therefore meet the effluent irrigation standards as outlined the Natural Resources Conservation (Wastewater and Sludge) Regulations, 2013

Table 5-6 Expected Treated Effluent Chemistry

Parameters of the Effluent treated (Services to the public with direct contact)		
Parameters	**Units**	**NRCA Irrigation Standard, 2013**
Faecal Coliform	MPN/100ml	12
Residual Chlorine	mg/l	0.5
Fats, Oils and Grease	mg/l	10
BOD5	mg/l	15
COD		<100
TSS	mg/l	1.5

5.2.7.3 Treatment Stages

The following stages of treatment will apply:

- Pre-Treatment
    - Roughing, Sanding and degreasing
- Biological Purification
    - Aeration Chamber
    - Secondary Chamber
- Tertiary Treatment
    - Disinfection with sodium hypochlorite
    - Ring Filtration
- Sludge Treatment
    - Sludge Thickening
    - Ship to drying beds

5.2.8 Roads

In general, all existing roads will be used as access roads trying to maximize the use of these existing paths to maintain natural spaces. The Main Access to the Resort will be made by using the existing access to the land from the North coast Highway (main road) and will be developed along the current path, adapting it to the logistical and traffic safety needs necessary for this use. This adaptation will have a smaller impact on the environment than making new roads using new paths.

Following the Main Access, we will arrive at a large roundabout that distributes the vehicular and pedestrian traffic to the different areas. One of these areas, accessible from that roundabout, will be the Casino. The main roads will be approximately 6.5 m wide with an additional 5 m which is divided into 2 m for streetlights and landscaping and 3 m for bike and sidewalk.

5.2.9 Boardwalk

A weave of boardwalks ("eco walks") will be installed throughout the property (Figure 5-14). The boardwalk will be wheelchair accessible and will be approximately 2.0 m wide (at the furthest edge to accommodate railings), with two (2) 3m x 3m viewing station areas for guest educational purposes and birdwatching. It is anticipated that it will be approximately 1 – 1.5 m above ground level or the highest anticipated water level. It will be constructed heartwood timber and placed on wooden piles. It will be constructed by using manual labour and no heavy equipment will be used.

All electrical, telecommunication, plumbing, gas, air conditioning and fire protection related utilities will be routed under the boardwalk in watertight piping.

5.2.10 Landscaping

The gardens and access roads will be reforested with native plants, greatly increasing the current forest of the land. There will be replanting of the possible trees that need to be removed by the construction. A landscaping plan will be prepared and submitted to the Agency for approval.

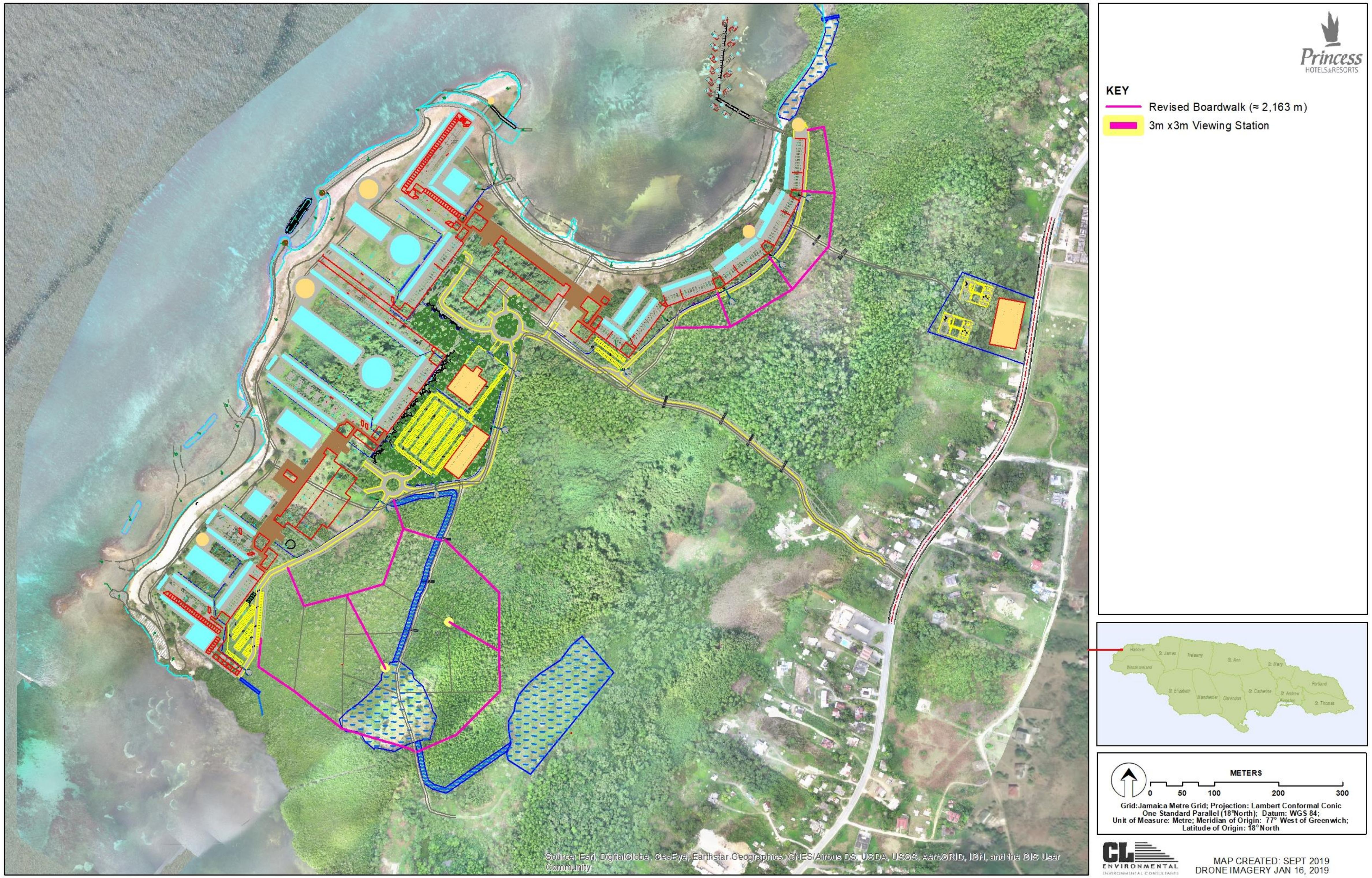


Figure 5-14 Map depicting locations of the proposed boardwalk

5.2.11 Parking

A total of 610 parking spaces are distributed in three distinct locations. These are: Hotel 1 (39 spaces), Back of House Area (425 spaces) and Hotel 4 (146 spaces).

5.2.12 Fire Protection System

Firefighting Facilities on the property will include emergency lighting and signals, fire detection devices and alarms, portable fire extinguishers and an elaborate water extinguishing system. These are detailed below:

5.2.12.1 Emergency Lighting and Signals

An emergency system shall be provided for lighting the exit routes. This consists of an autonomous emergency lighting system, which will be activated automatically in case of interruption of the normal or backup power source. The lighting is done by means of autonomous emergency lamps with battery and directional lights or with ordinary luminaries of the building when they have emergency ballast. Emergency lighting will be placed along the routes of evacuation, hallways, access to emergency exits, stairs, discharge of stairs and other means of evacuation. The emergency lighting shall have the following characteristics:

- Power Source Autonomy: 90 minutes
- Capacity: 10 lux average at the start and 1 lux along the tracks measured at ground level
- Capacity at the end of the battery charge: Average not less than 6 lux and 0.6 lux at the end of the duration of the illumination.

All exits and access routes shall be indicated by visible signs. Doors, hallways or stairs that do not lead to the exit, but which are in a way that can lead to mistakes, will be marked with signs or with the text "NO EXIT". The signs shall be of such size, color and shape as to be readily visible.

5.2.12.2 Fire Detection and Alarms

There will be a system of detection and alarm, which, in case of fire, will warn the occupants of the building in an early manner, by means of an audible and visual signal. The system shall be activated by smoke or temperature sensors, manual stations or an automatic sprinkler system and shall alert the occupants by audible and visual signals.

The detection and alarm system will consist of the following elements:

<u>Activation Devices:</u>

- Smoke detectors to be placed in all rooms susceptible to fire.
- Temperature detectors to be placed where smoke detectors are susceptible to false alarms (e.g. kitchens, garages).
- Manual fire alarm levers which allow the occupants to operate the alarm intentionally.

- Opening sensors in emergency doors.
- Flow sensors in the piping of the fixed system against fire.
- Start sensor in the fire pumps.

Advertising devices.

- Fire bell
- Strobe lights (flashing)
- Speakers
- Remote notification panels

Other components.

- Main control panel to be placed in a site with supervision and that is accessible
- Main power system.
- Auxiliary power system (backup battery).
- Control of automatic doors.
- Air conditioning control.
- Control of elevators.

5.2.12.3 Portable Fire Extinguishers

Portable extinguishers will be either carbon dioxide extinguishers of 4.54 kg for BC fires or dry chemical extinguishers of 4.54 kg for ABC fires.

5.2.12.4 Water Extinguishing System

Pump System

The pumps of the Fire Pressure Group will be centrifugal pump units, driven by a diesel internal combustion engine, for which fuel reserves will allow their continuous operation for 8 hours. The pump system will be designed according to the requirements of the NFPA 20 edition 2010 or the equivalent in the most recent versions. Horizontal centrifugal pumps will always operate on load (positive suction). Horizontal centrifugal pumps with the possibility of downhole will not be permitted, even if they have priming reservoirs with automatic water replenishment.

The minimum flow rate to be guaranteed by the Fire Pressure group is described in Table 5-7.

Table 5-7 Fire pressure group flows

FIRE PRESSURE GROUP FLOW			
Level of risk	**Flow (lpm)**	**Tank (m³)**	**Flow (l/h)**
HIGH	3.600	480	216.000
MEDIUM	1.800	240	108.000
LOW	900	120	54.000

Supply Tank

The water supply must be sufficient to supply the rated flow rate of the fire pump for at least 30 minutes. The tank can be shared for production processes and for firefighting, as long as the pump suctions are installed at different heights so that the water reserve for use in the event of a casualty is always available and there is no possibility that it is used in the building's normal processes or services.

Piping System

The piping system was designed taking into account the losses due to length, accessories, reference level, water supply and others. It consists of a system formed by a closed hydraulic circuit, allowing by means of valves that if one section is damaged, the intakes are fed by the other section. The maximum pressure at any time and at any point of the system must not exceed 24 bar (350 psi). The cabinets or hose connections will be equipped with the corresponding diameters for the type of system to be installed and distributed in each level so that from the cabinet to the farthest point to be protected inside the building is not more than 40 m.

Combination Standpipe

Combination standpipes will have a check valve, in addition to the swing check valve that the Siamese combination standpipe has. It shall be installed in such a way as to be accessible to firefighters and not more than 30 meters from the power supply.

Manifold Test

A test manifold will be installed according to the capacity of the pump, according to NFPA 20 edition 2010 or equivalent in the most recent versions. Each outlet will have a gate valve. The separation between mouths will be between 30 and 40 cm. A gate valve will be installed between the test manifold and the feed pipe for maintenance or repair.

Exterior Hydrants

This network will be responsible for the water supply of the fire network to all hydrants located outside the buildings. Hydrants will be considered as a source of backup water supply for fixed fire extinguishing systems. Hydrants will be located on the ring main at intervals to suitably direct water to the fire hazard they protect for hotel facilities.

The location and distribution of hydrants should be performed according to the following criteria:

1) The protected area for each hydrant will be covered by a radius of 40 m, measured horizontally from the location of the hydrant.
2) At least one of the Hydrants (if possible, at the entrance) must have a 100 mm outlet
3) The distance between the location of each hydrant and the outer limit of the building or Protected area, must be between 5 m and 15 m.
4) The hydrants will be located in easy-to-access areas.

5.2.13 Beach Works

There will be beach works which will include the creation of:

1. Six rock groynes
2. Three rock revetments and perched beaches.
3. One ~1.5m deep flushing channel fortified with two bank revetments
4. One water sports jetty made from concrete armour units.
5. Two submerged breakwaters
6. One emergent breakwater

These are displayed in Figure 5-15 to Figure 5-18.

The estimated amount of dredge spoils to be generated is approximately 6,000 m^3. Suitable dredged material will be used as fill material on site where needed. Dredged material will be placed in a bermed holding area for dewatering after the fines have settled and then the suitable material used as fill on site while the remaining excess material (approximately 200 m^3) will be transferred to trucks and disposed of at an approved disposal site (Retirement Disposal Site, St. James). Sand for beach works will either be imported from the Bahamas or manufactured sand used.

The beach works will be subject to a separate application by Smith Warner Intl.

5.2.14 Concrete Batching Plant

A private contractor will supply all the concrete for project from a batching plant to be installed on a site provided by the Client. The concrete will be supplied in 4 different classes:

- Concrete type 3.500 psi., Foundation Mix. (white sand/stone aggregates)
- Concrete type 3.500 psi., Wall Mix. (black sand/stone aggregates)
- Concrete type 4.000 psi., Foundation Mix.
- Concrete type 4.000 psi., Wall Mix.

It is estimated that the quantity of concrete to be supplied will be no less than 22, 937 m^3 (30,000.00 cubic yards) over a period of 2 years.

The batching plant will be the brand Frumecar, which is electronically operated with wet mixer that guarantee mix quality. The supply of the concrete from the batching plant will be at a nominal capacity of 40 m^3/hour. Normal working time will be 9 hours per day starting at 8:00 am (Monday to Saturday) for week 1, and Monday to Friday for week 2.

The private contractor will be responsible for:

1. The maintenance and operation of the Batching Plant for 24 months.
2. The procurement of raw materials (excluding the aggregates if the Client provides), supply, transport, pouring and internal quality control of concrete.
3. The necessary equipment associated to execute the effective concrete supply based on but not only:
    - Concrete trucks for the transport of concrete.
    - Internal Quality control laboratory for concrete testing.
    - Backhoe for movement of aggregates.
    - Generator on site, 170Kva for exclusively use of the batching plant.
    - Offices and storage room.

The concrete plant will be located on a 5,500 m^2 of land earmarked for Phase 2 (Hotels 1 and 2) and will have an aggregate area (sand and gravel), an area for a generator, office and storage rooms and an area for washing the inside of the premix trucks (Figure 5-22).

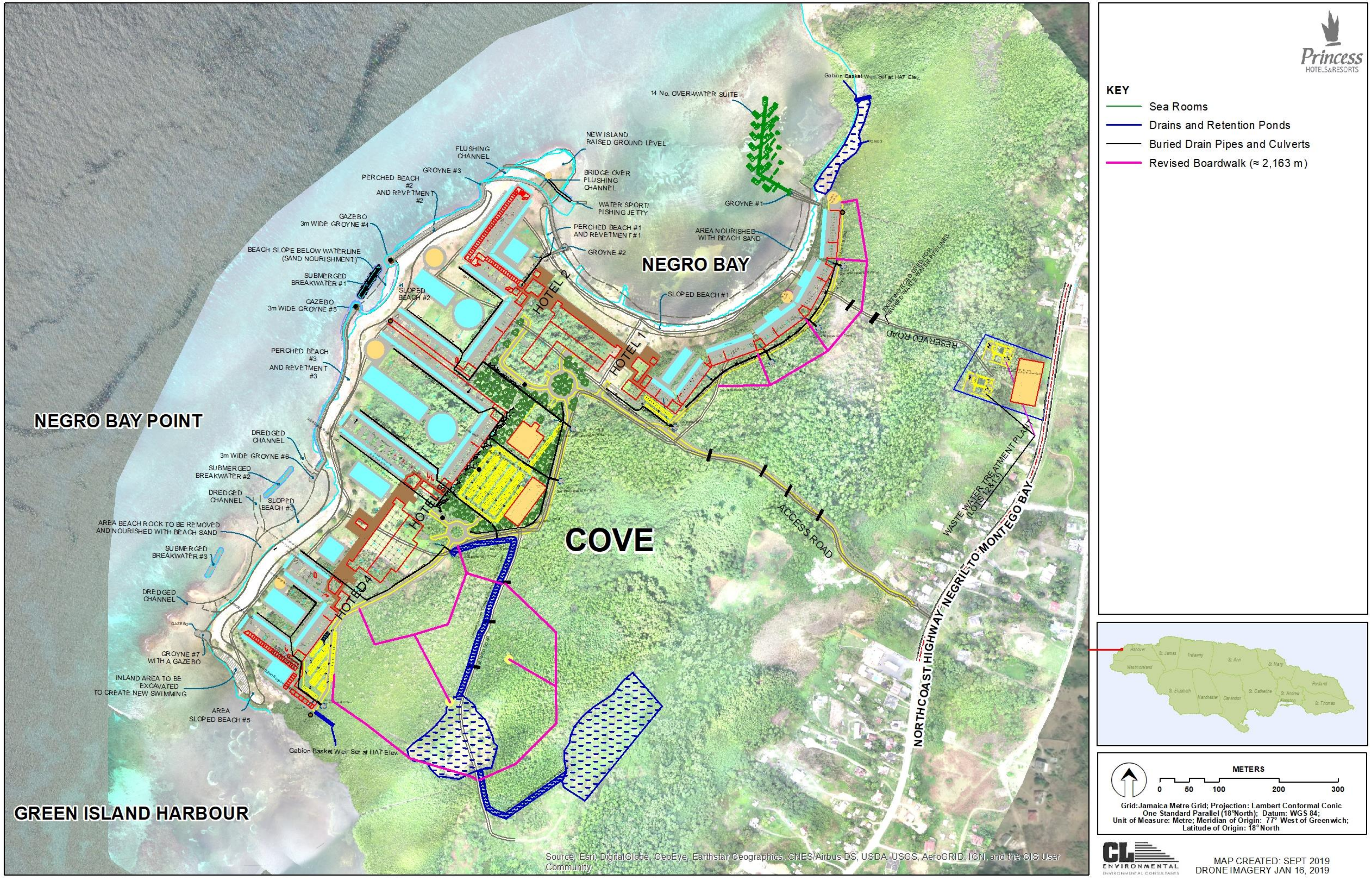


Figure 5-15 Proposed beach works (source Drawing from Smith Warner International)

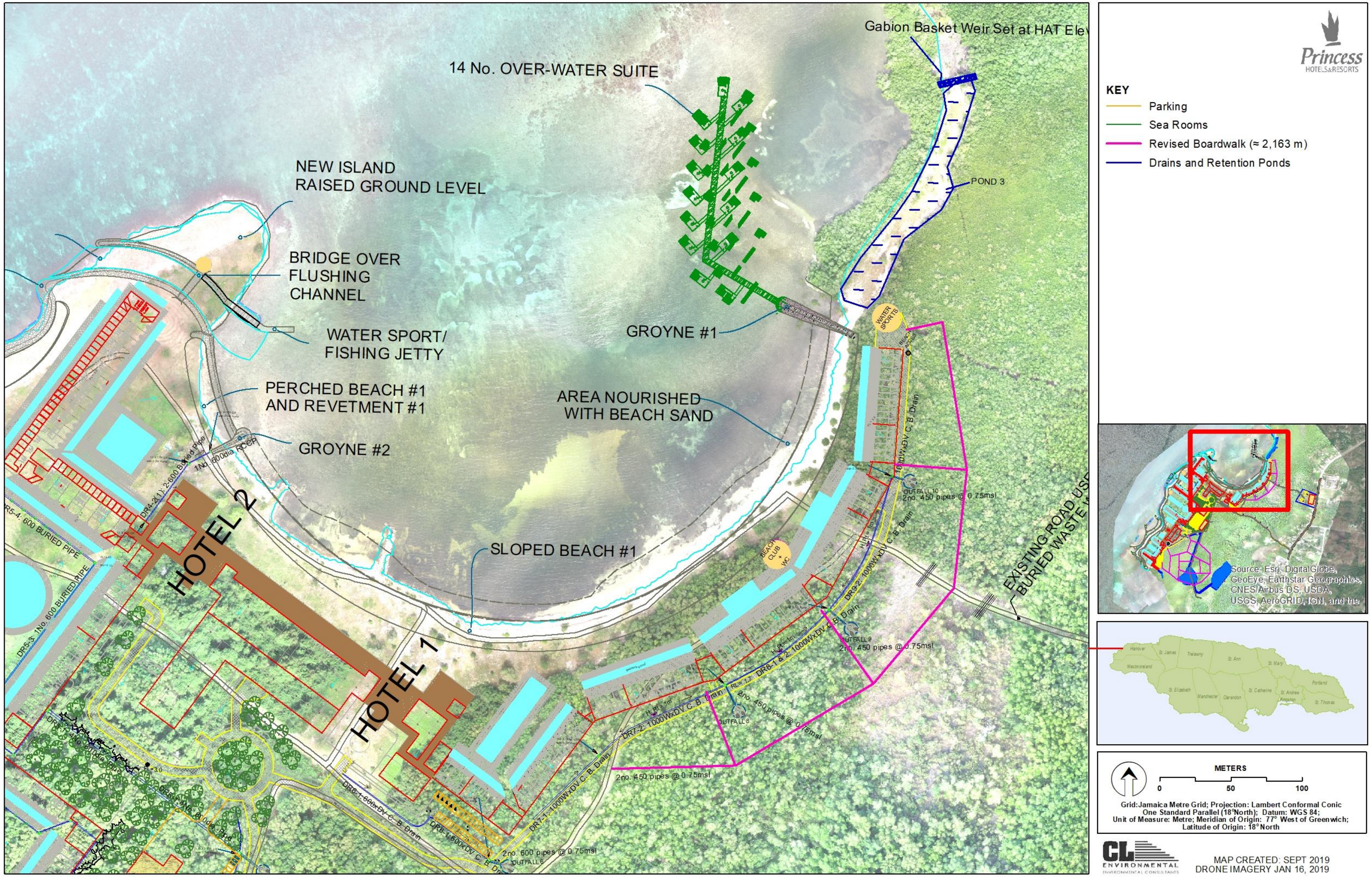


Figure 5-16 Proposed beach works area (Negro Bay) zoomed in

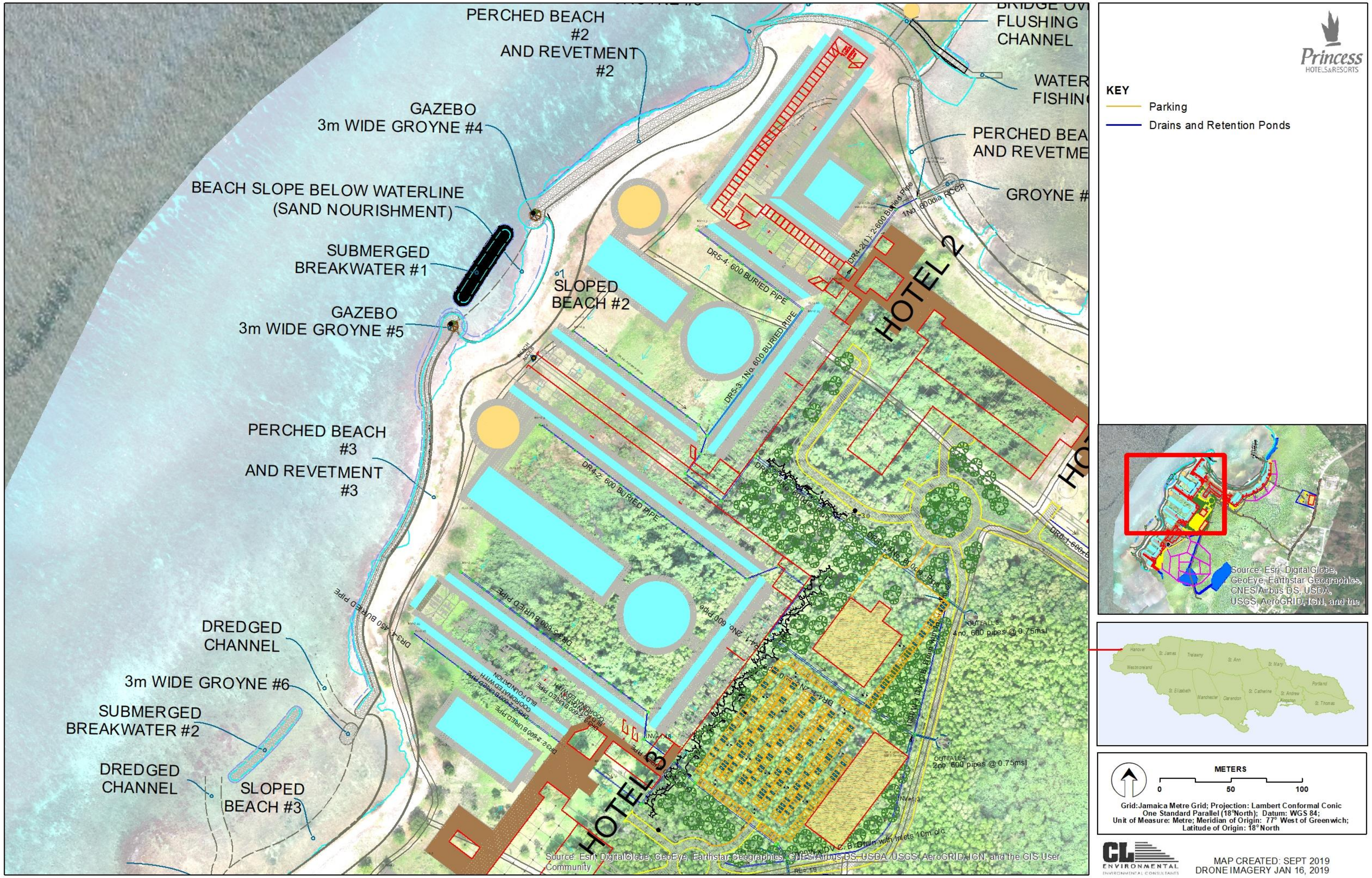


Figure 5-17 Proposed beach works area (Negro Bay Point) zoomed in

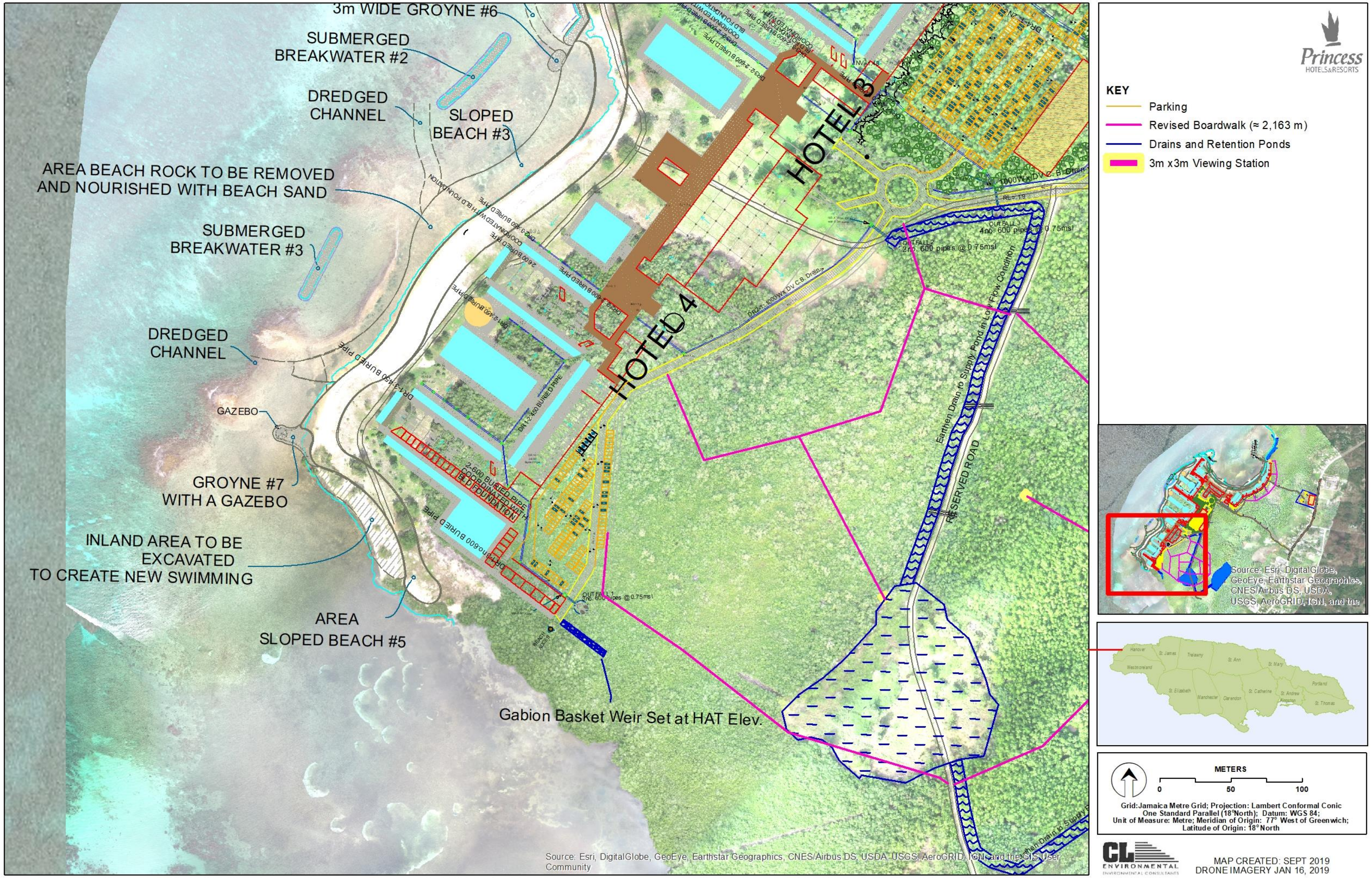


Figure 5-18 Proposed beach works area (Negro Bay/Green Island Harbour) zoomed in

5.3 LOGISTICS

The floor space of Phase 2 of the construction will be utilized to situate the following facilities:

a) Prefabrication Plant
b) Concrete Batching Plant
c) General Materials Warehouse
d) Cafeteria for 250 diners. (with enough space to expand to double that capacity).
e) Field Offices for technical personnel.
f) Taking advantage of the design of the project's own pathways (3,750 m long of varying widths). During the construction period, these will be kept as dirt roads which will afterwards be given appropriate finishing (reinforced concrete) of approximately 7,720 m^3. A daily circulation of between 50 and 120 trucks and cars is estimated during construction.
g) Four (4) Sanitary Modules (Work restrooms), with easy access to discharge everyday waste through sewage pipes. Due to their size and shape it will be easy to increase the number of sanitary modules according to the work requirements (Figure 5-19).

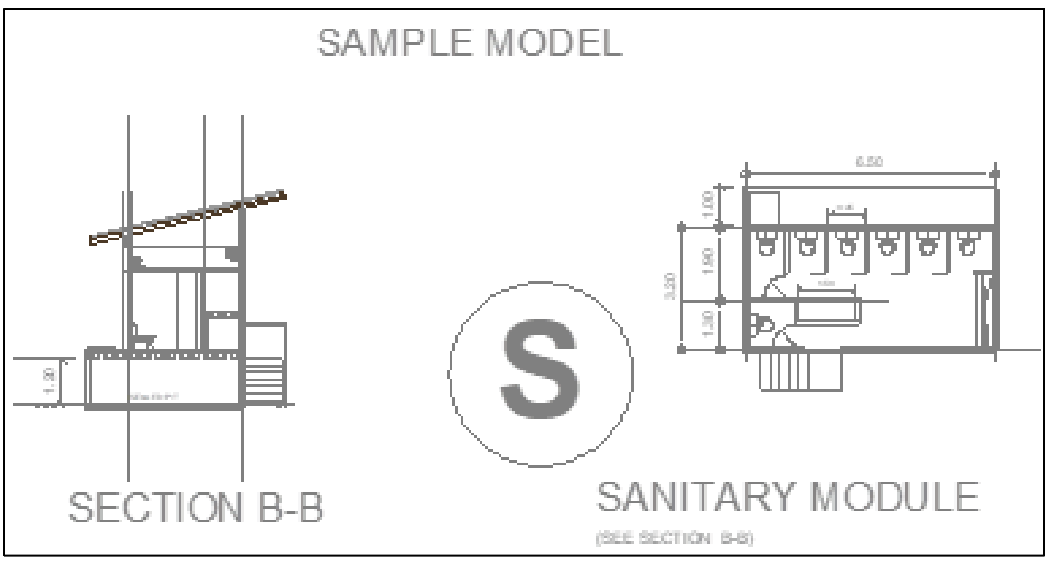


Figure 5-19 Sanitary modules

5.3.1 Pre-Fabrication Area

5.3.1.1 Prefabricated Structures

The prefabrication works are divided into two fundamental stages:

1. The prefabrication work (done in a Prefabrication Plant).
2. The assembly (performed during construction)

Prefabrication

The prefabrication of required components will be carried out in the Prefabrication Plant of area 45,000 – 50, 000 m^2, divided into the following sections:

a) Technical and Administrative Area: Field Offices, Restrooms, Storage Rooms, Laboratory, Welding workshop and Warehouses (for steel rods, mesh, prestressed material, and reinforcing steel).
b) Prefabrication Area: Enabling area and reinforcing steel grid assembly, casting of columns, beams and slabs.
c) Storage area for prefabricated components.

The prefabrication plant layout is shown in Figure 5-20 and Figure 5-21.

Figure 5-20 May depicting the locations of the concrete batching plant and the prefabrication area

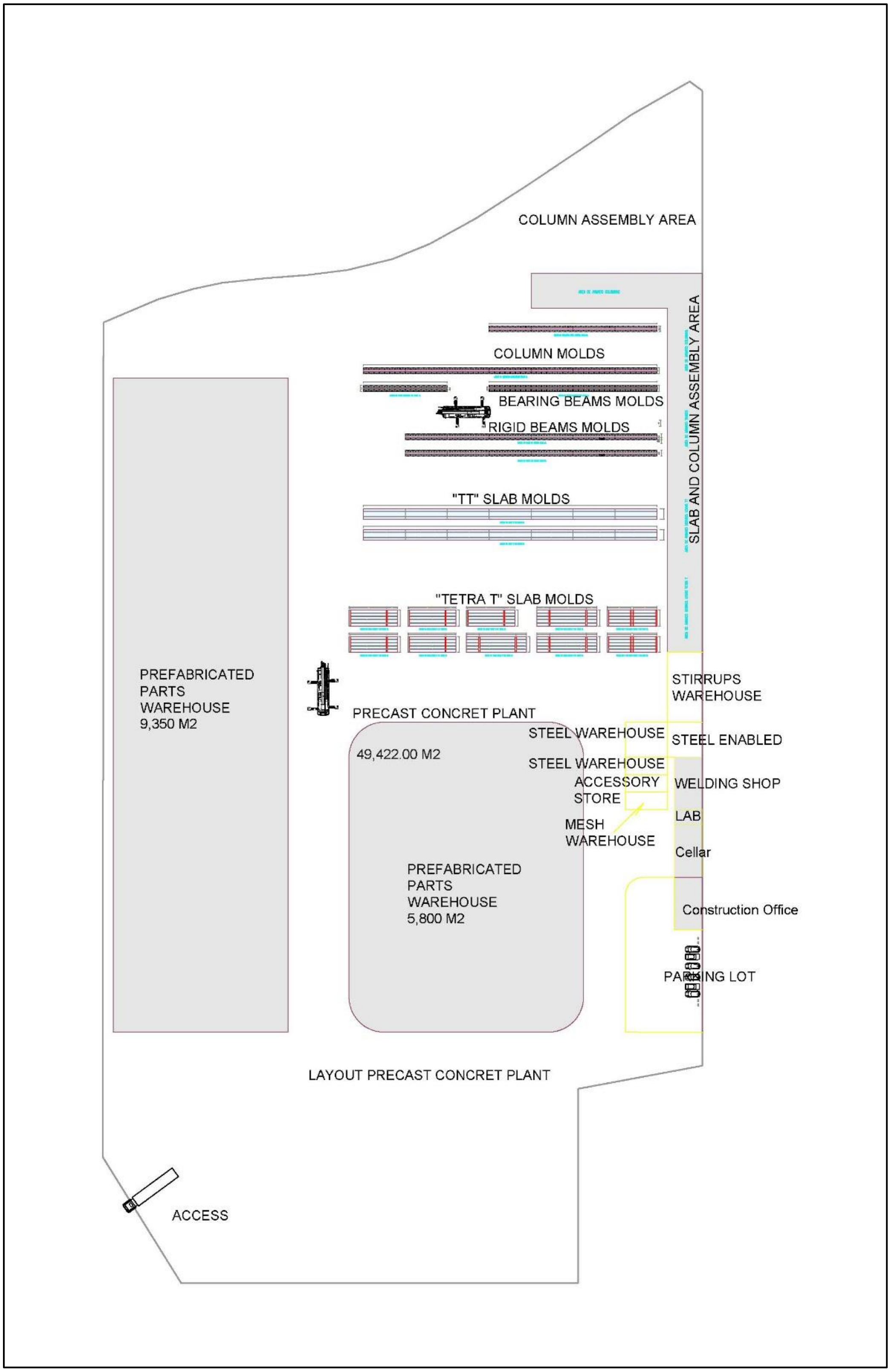


Figure 5-21 Layout of Prefabrication plant

Assembly

The assembly process involves:

1. Plotting by using precision devices
2. Excavation to house the “candlestick” footings. Concrete is poured into excavations to obtain uniform and stable surface for placement of the prefabricated structure (Plate 5-1).
3. The “candlestick” footings are placed then casting is conducted with grout to ensure footing remains securely seated in place, ensuring that the loads are properly transmitted (Plate 5-2).

Plate 5-1 Concrete poured into excavation

Plate 5-2 Candlestick footing placed inside excavation

4. Filling of the stump is done using a soil-cement mix and then compacted in layers no greater than 30cm until desired level is reached (Plate 5-3).
5. The placement of the Prefabricated columns is done using a precision device from Step 1. The columns are placed in the candlestick footings and set with grout (Plate 5-4).

Plate 5-3 Filling of stump and compaction

Plate 5-4 Columns placed in candlestick footings

6. When a sufficient number of columns have been placed and raised, the prefabricated beams are then placed. These are freely supported on the corbels of the columns on a previously placed neoprene plate. The beams are fixed on the nodes via welding. The welding will simply serve to prevent the beams from rotating before they receive the "double T" slabs (Plate 5-5).
7. Once a quantity of beams (proportional to the area that is being constructed) are in place, the prefabricated double T slabs are then placed. These are freely supported on the beams.
8. Finally, reinforced steel is laid depending on the working loads of the different areas. For this project, only two types of areas are considered: pedestrian and traffic. Pedestrian areas will only be reinforced with electro welded mesh 6.6/10.10, (Plate 5-6). For vehicular traffic areas these would be reinforced with a foundation grid of ½" steel rods @ 15 cm, c. c. a. s.

Plate 5-5 Beams placed atop columns

Plate 5-6 Reinforcement of areas using electro welded mesh

5.3.2 Employee's Dining Room, Industrial Building and Construction Materials Warehouse

5.3.2.1 Employee's Dining Room

An employee's dining room will be constructed with kitchen facilities to provide food for the construction workers on the site. An area of approximately 475m^2 is earmarked form this facility (Figure 5-22).

5.3.2.2 Industrial Building

A 2,345 m^2 industrial building will be constructed which includes approximately 250 m^2 Supervisory Office for the construction team. The location is depicted in Figure 5-22. Attached to this is a 260 m^2 show room. The central air conditioning facilities room will also be located in the Industrial Building.

5.3.2.3 Construction Materials Warehouse

An 1,800 m^2 construction materials warehouse will be erected to facilitate the construction of the proposed hotel project. The location of which is illustrated in Figure 5-22.

Figure 5-22 Map illustrating the locations of the employee's dining room, industrial building and construction materials warehouse

5.4 PROJECT DESIGN AND COMPONENTS

The project area currently has two man-made coastal structures; however, it is still a very natural looking coast. Engineering solutions are needed to develop a resort-grade beach and effectively protect the Princess Resorts property shoreline under extreme events. This section presents considerations and calculations in the design of the structures. Boundary conditions used for the calculations are presented first, after which the sizing of the armour stones is described.

5.4.1 Design Parameters

For the design of the structures, the maximum wave heights incident on each structure for a different wave forcing were extracted from the MIKE21 model. For this design, we must consider the wave conditions on the structures under:

1. Daily wave conditions;
2. Swell events; and
3. Hurricane conditions.

The use of a return period or design event such as the 1 in 50-year or 1 in 100-year essentially defines the kind of design conditions that will, on average, occur or be exceeded once every 50 years or every 100 years. It is important to understand risk and consider the chance of occurrence of a particular storm condition during the lifetime of a structure so that the associated risk of damage can be understood.

Table 5-8 gives the exposure risk (probability) over a project lifespan for different return period events. For example, a project lifespan of 50 years (Design Life =50) has a 99% chance of a 1:10-year event occurring and a 39% chance of a 1:100-year storm event occurring in 50 years.

Table 5-8 Probability of occurrence for various return periods and design life

Storm Event Return Period (years)	Design Life (years)			
	25	50	100	200
10	93%	99%	100%	100%
25	64%	87%	98%	100%
50	40%	64%	87%	98%
100	22%	39%	63%	87%
200	12%	22%	39%	63%
500	5%	10%	18%	33%

For submerged structures, the wave forces become less as the water level increases so designing for a 1 in 50-year storm versus a 1 in 100-year storm does not have much impact on the resulting stone sizes. However, for emergent structures that become exposed to wave breaking, cost savings can be made by adopting a lower return period as the design criteria. Structures were designed using the 1 in 50-year storm event, which is usually the recommended design return period for the design of coastal engineering structures. Wave conditions for use in the design were extracted at points where structures are proposed as shown in Figure 5-23. Table 5-9 summarizes the design wave conditions for each of the structures. The rows are colour coded to correlate with the coloured points on the structures in Figure 5-23.

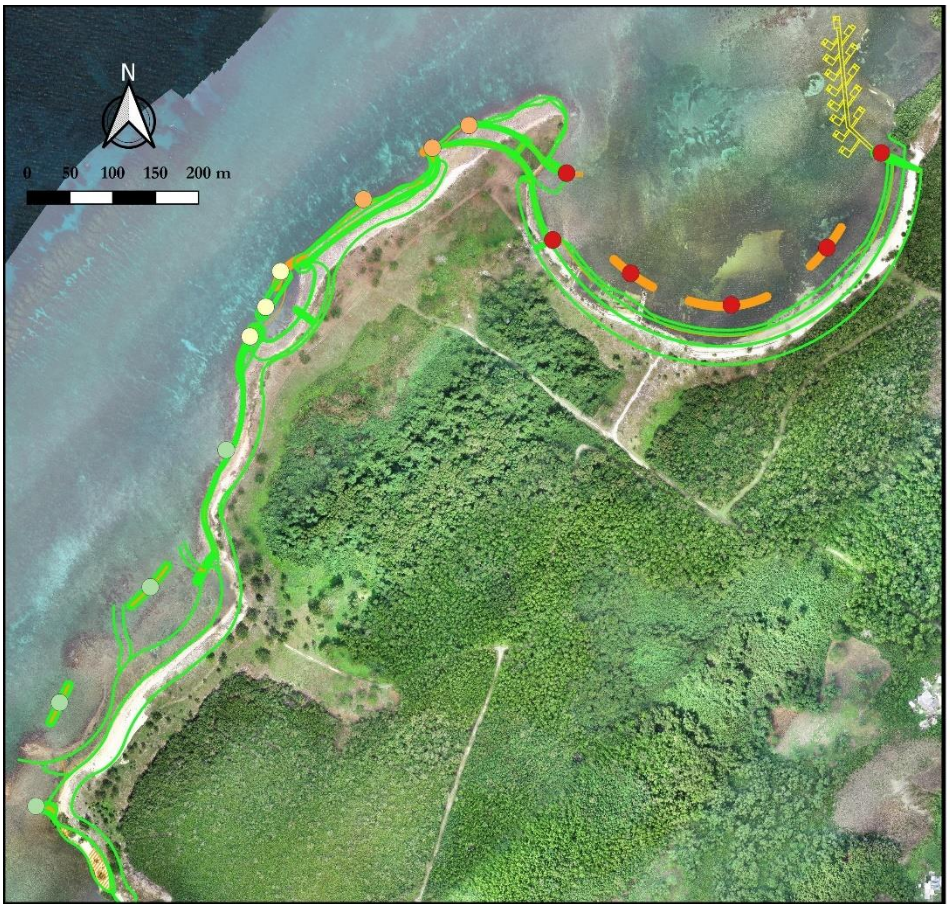


Figure 5-23 Points used for wave conditions extraction

Table 5-9 Wave conditions (1 in 50 year return period) used in coastal engineering designs

Significant Wave Heights, Hs(m)	*Peak Wave Period, Tp (s)*	*Wave Direction*
1.0	11.46	NNW - NNE
1.5	11.46	NNW
2.5	11.44	NW
1.5	11.46	WNW

5.4.2 Engineering Design of Coastal Protection

This section of the report presents the structural design for the recommended coastal enhancement measures including (i) calculations to specify suitable revetment elevations to limit overtopping during storm conditions and (ii) calculations for the stone sizes that would be stable during a 1 in 50-year hurricane event.

5.4.2.1 Structural Elevation for Revetment and Groyne

Overtopping occurs when waves run-up or crash into structures along the coast. A major consequence of this overflow is flooding at the site. Overtopping is therefore a major concern where wave heights are not reduced before reaching the site. This occurs along the rocky shoreline of Hotels 2 and 3.

Structures along this stretch of shoreline therefore include:

- Revetment for the perched beach
- Cove beach using groynes.

Overtopping rates are determined using swell and hurricane conditions as previously described. Results shown in Table 5-10 are for a structure with a crest at 2.5m above MSL and a 1:2 slope. This ensures the specified structure heights are enough to reduce overtopping rates and avoid structural damage under operational and extreme events. Wave overtopping along the shoreline of Hotels 2 and 3 during hurricanes should be less than 10-20l/s for people to stay safe (Table 5-11). To prevent damage to the structure behind the revetment, the overtopping should be further reduced to less than 5-10l/s (Table 5-12).

Table 5-10 Overtopping rates for swells and hurricanes

	Overtopping Rate	
	Swell Event	Hurricane Wave
Hotels 2 -3: Revetment and Groynes *Slope of 1:2* *Crest Height: +3.0m MSL*	0.417 1/s/m	1 1/s/m
Hotel 2 – 3: Cove Beach Groyne Slope of 1:2 Berm of 4m at +1m MSL Crest Height: +2.5m MSL	0.565 1/s/m	8 1/s/m

Please note that the groynes would have to be almost 17m wide to achieve the limited overtopping as calculated above. The design was therefore optimized by the following means:

- The groyne was stopped on land and set to the elevation of the revetment (i.e. +3 MSL).
- The submerged breakwater was widened to create more breaking and reduce the run-up potential of the waves.

Table 5-11 Limits for overtopping rates for people and cars behind revetment (EuroTop, 2016)

Hazard type and reason	Mean discharge q (l/s per m)	Max volume V_{max} (l per m)
People at structures with possible violent overtopping, mostly vertical structures	No access for any predicted overtopping	No access for any predicted overtopping
People at seawall / dike crest. Clear view of the sea.		
H_{m0} = 3 m	0.3	600
H_{m0} = 2 m	1	600
H_{m0} = 1 m	10-20	600
H_{m0} < 0.5 m	No limit	No limit
Cars on seawall / dike crest, or railway close behind crest		
H_{m0} = 3 m	<5	2000
H_{m0} = 2 m	10-20	2000
H_{m0} = 1 m	<75	2000
Highways and roads, fast traffic	Close before debris in spray becomes dangerous	Close before debris in spray becomes dangerous

Table 5-12 Limits for overtopping rates structural damage behind revetment (EuroTop, 2016)

Hazard type and reason	Mean discharge q (l/s per m)	Max volume V_{max} (l per m)
Rubble mound breakwaters; H_{m0} > 5 m; no damage	1	2,000-3,000
Rubble mound breakwaters; H_{m0} > 5 m; rear side designed for wave overtopping	5-10	10,000-20,000
Grass covered crest and landward slope; maintained and closed grass cover; H_{m0} = 1 – 3 m	5	2,000-3,000
Grass covered crest and landward slope; not maintained grass cover, open spots, moss, bare patches; H_{m0} = 0.5 – 3 m	0.1	500
Grass covered crest and landward slope; H_{m0} < 1 m	5-10	500
Grass covered crest and landward slope; H_{m0} < 0.3 m	No limit	No limit

5.4.2.2 Armour Stone Sizes for Revetment, Breakwaters and Groynes

In recent years, shoreline armour structures have been designed to be built with boulders or, where boulders are unavailable or less cost effective, concrete armour units. Based on our research, boulders of suitable size and strength are available in Jamaica. Sizing rocks for armour structures depends primarily on the stability of the rocks under wave forcing. The revetments, groynes and breakwaters were designed using an in-house spreadsheet for determining armour stone sizes from the design wave conditions based on work by Van der Meer (2003) and Van Gent (2004). These two design methods were selected because they specify formulations for structures in shallow water where the water depth is less than three times the wave heights. This shallow water condition would exist at the base of the revetment when the static water level is increased under the influence of a hurricane.

The following assumptions are also made for the calculations:

- Stones will have a minimum density of 2500kg/m^3;
- A total of two stones can be displaced per meter run after the passage of a 1 in 50-yr hurricane;
- The slope of the structure revetment is 1(H):1.5(V);
- The revetment will have a permeability of 0.3 and will be constructed with a stone filter layer;
- Storms are assumed to have a duration of 8 hours.

With these assumptions and the wave conditions previously calculated, stone sizes were calculated. From the output of these calculations we found that the van der Meer (2003) formulation gave larger stone sizes than the van Gent (2004) formulations. We selected the van der Meer results, which are somewhat more conservative, and the specifications for the calculations are shown in Figure 5-24.

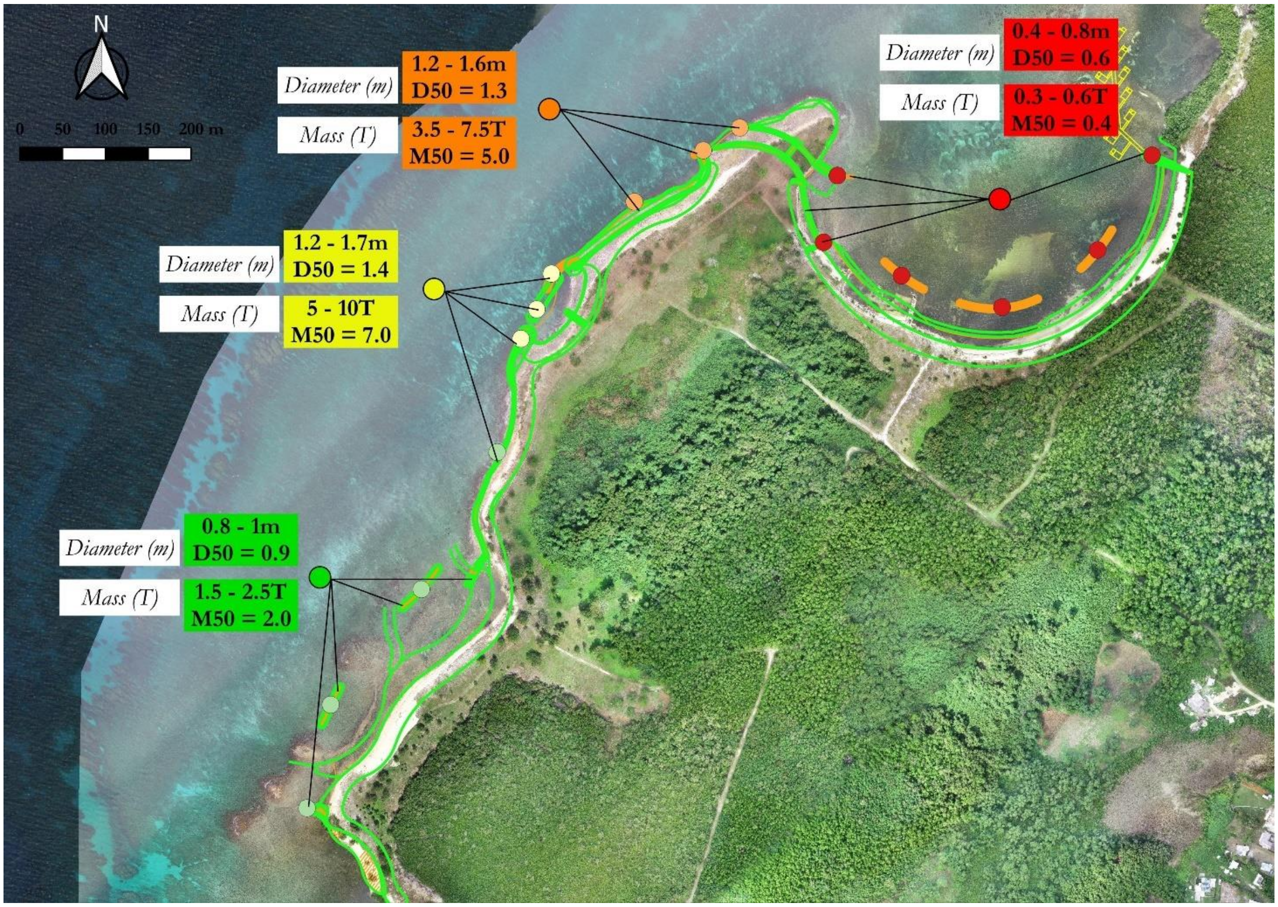


Figure 5-24 Stone sizes at the various shoreline sections of the site

5.4.2.3 Structural Elevation for Sea Rooms

The proposed sea rooms should be set at an elevation that limits the potential for flood under extreme events such as hurricanes. The protection is provided by the “airgap” according to the guidelines for piers and jetties (K. McConnell, 2004). The floor elevation should be set based on:

1. **Static Water Level:** This refers to the High Astronomical Tide (HAT), Sea Level Rise (SLR), and Inverse Barometric Pressure (IBR))
2. **Height of the Wave Crest** (ηMAX) – in deep water the water elevation can be determined using an equation as follows:

$$\eta_{MAX} = \frac{H_{MAX}}{2} \exp\left(\frac{2\pi}{L_m}\frac{H_{MAX}}{2}\right)$$

However, the depth of water at the Sea Rooms is shallow so MIKE21 and sBEACH models were used to obtain to chest elevation of the waves.

3. **Allowance for Service Entities** (i.e. utilities, sewage and drainage, etc.).

Floor levels were developed for hurricane and swell wave conditions. Hurricane conditions would cause the greatest increase in the static water level and, combined with the large waves, there is potential for extreme flooding to occur. However, swell waves can also cause a notable increase in the wave heights. Therefore, a two-level approach was taken in setting the Sea Room floor elevations; The lower level is closer to sea level and could be a platform for entering and exiting the sea. The building elements placed on this lower platform should be mobile as this level would be flooded during a hurricane (Figure 5-25). The upper level would not be flooded during hurricane conditions and could house more permanent items (Figure 5-26). Figure 5-27 is a sketch showing the two-floor approach described above.

Table 5-13 Recommended Floor Levels

Hazard	*Components*	
Hurricane	• Static water level	• 0.94m
	• Height of wave crest	• Variable: 1.13-1.26m
	• Allowance for services	• 0.6m (~2ft)
Hurricane Flooding Protection: +2.75m MSL		
Swell	• Highest astronomical tide	• 0.25m
	• Height of wave crest	• Variable: 0.3-0.4m
	• Allowance for services	• 0.6m (~2ft)
Swell Wave Flooding Protection: +1.25m MSL		

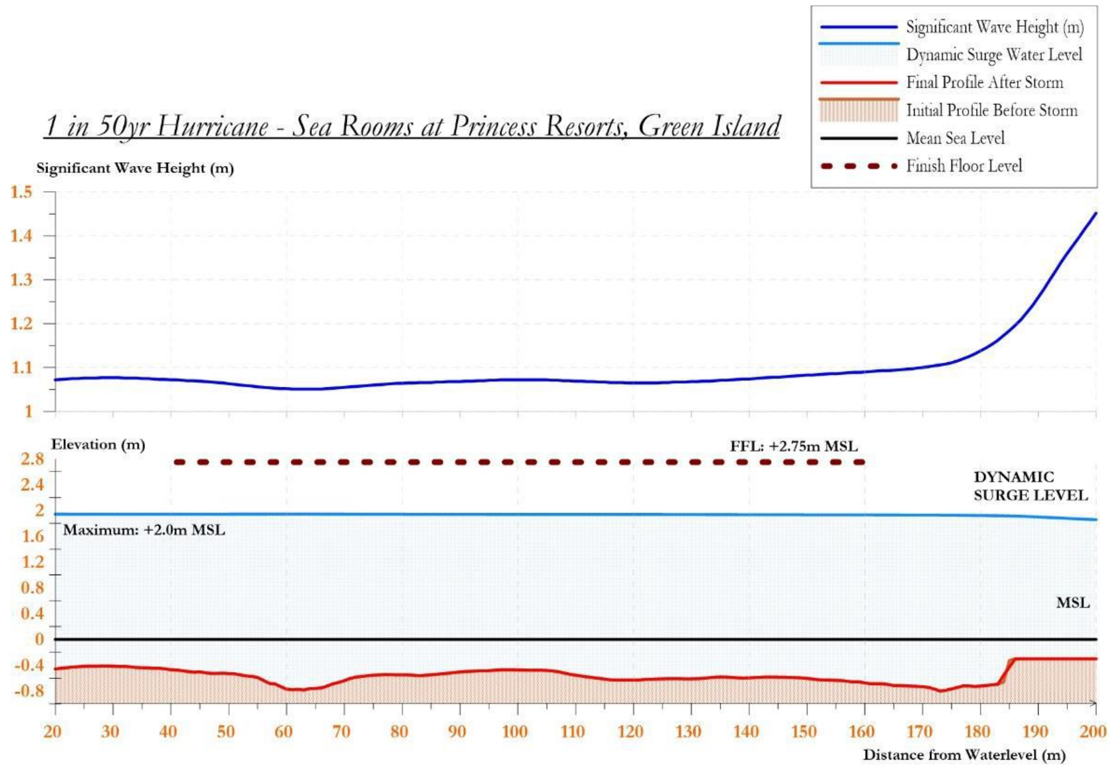


Figure 5-25 Water elevation along the footprint of the searooms under hurricane conditions

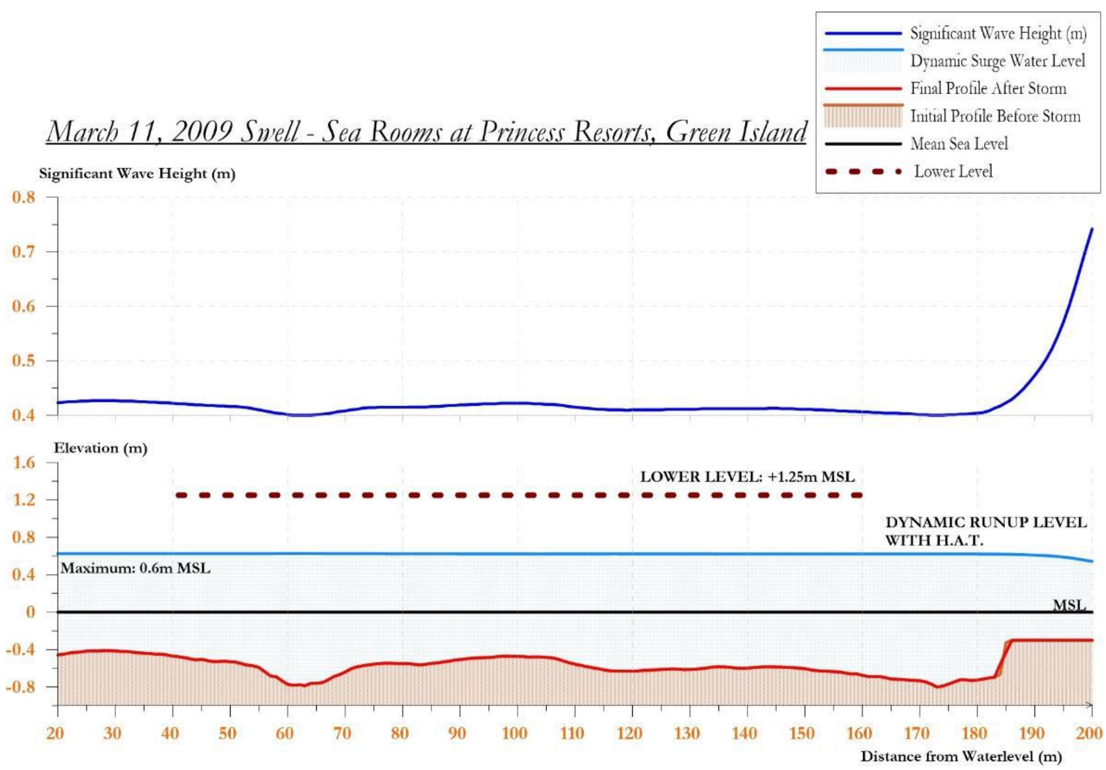


Figure 5-26 Water elevation along the footprint of the searooms under swell conditions

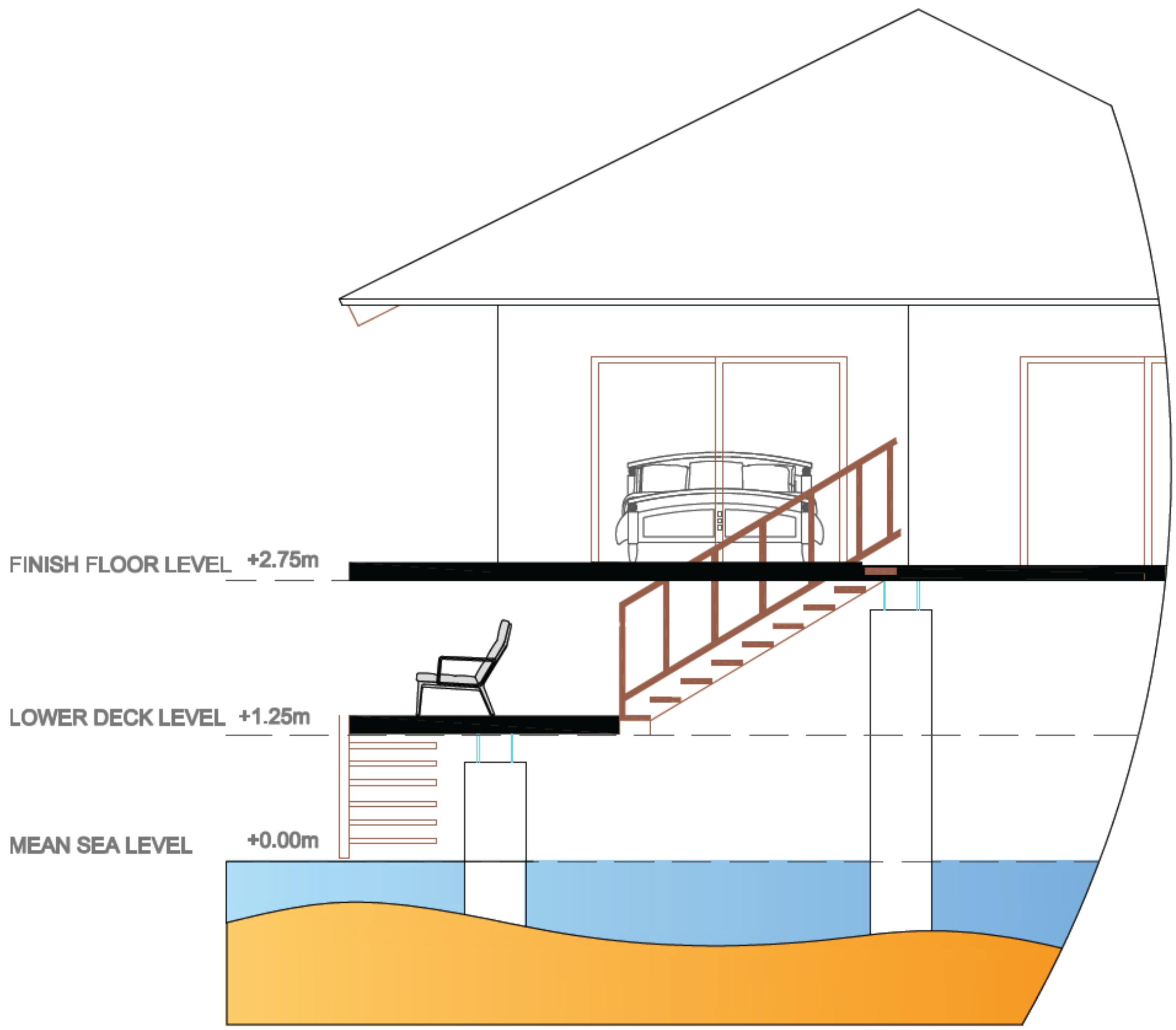


Figure 5-27 Floor level recommendations for searooms

5.4.3 Preliminary Quantities

Preliminary quantities of boulders for groyne, breakwater and revetment construction are shown in Figure 5-28. It also shows preliminary quantities of sand for beach nourishment and dredge volumes.

Figure 5-28 Preliminary quantities of boulders and sand for beach works

5.5 EMPLOYMENT

The work force for the site will at peak time be approximately 1,500 trade men and labourers and should range from 700 -1500 during construction. This should create approximately 2,660 - 5,700 indirect and induced jobs during construction. To the extent practicable, Princess Hotels and Resorts will utilise local skills and labour for construction and operation of the hotel.

5.6 CONSTRUCTION METHODOLOGY

5.6.1 Hotel

5.6.1.1 Preliminary Work

Ground Mechanics

In order to obtain optimal results a Mixed Soil Mechanics study will be conducted. Exploratory probes will be sunk at depths ranging from 9m to 30m. The probes will be advanced using hollow shank augers (H.S.A.) coupled to CME 55 drilling rigs (Plate 5-7). The depth of the water table at the end of the drilling will be recorded in each drilling hole and additional readings will be taken 24 hours after completion. An Electrical Resistivity Geophysical Survey will also be conducted to create profiles of what exists under the land. A minimum of 10 to a maximum of 25 profiles will be created, depending on the condition of the terrain.

Prior to the implementation of the aforementioned surveys, various mangrove areas on the site will be filled in order to allow access to the different points. Appropriate laboratory tests will be performed to classify the main soil strata according to the ASTM D2487 Unified Soil Classification System (USCS), Grain Size Distribution (ASTM D6913), and Natural Moisture Content (ASTM D2216).

GEOTECHNICAL ANALYSIS AND FOUNDATION RECOMMENDATIONS:

Survey records will be used to build Stratigraphic Profiles along selected sections, which will then serve as the basis for geotechnical modeling. The seismic site class will be calculated from the SPT-N values. The liquefaction potential will be determined from the SPT-N values, the soil type, the grain size distribution and the fine content.

Plate 5-7 CME 55 Drilling Rigs

Mangrove Area Fillings

The sites for the hotel buildings where mangroves currently exist will be filled according to the following processes:

1) Excavation and removal of approximately 14,656.13 m^3 of peat within the building footprint. This peat will be used for landscaping activities on the hotel property.
2) Depending on the depth of the mangrove area, a Filter Layer will be constructed using different sizes of rocks, which will which range in size from 10 to 20 cm., 30 to 50 cm., and 60 to 90 cm.
3) A work surface and/or platform will be built using compactable material.
4) A platform made up of layers will be constructed until the desired level is reached, from 25 to 30 cm compacted to 95% PROCTOR.

This is displayed in Figure 5-29.

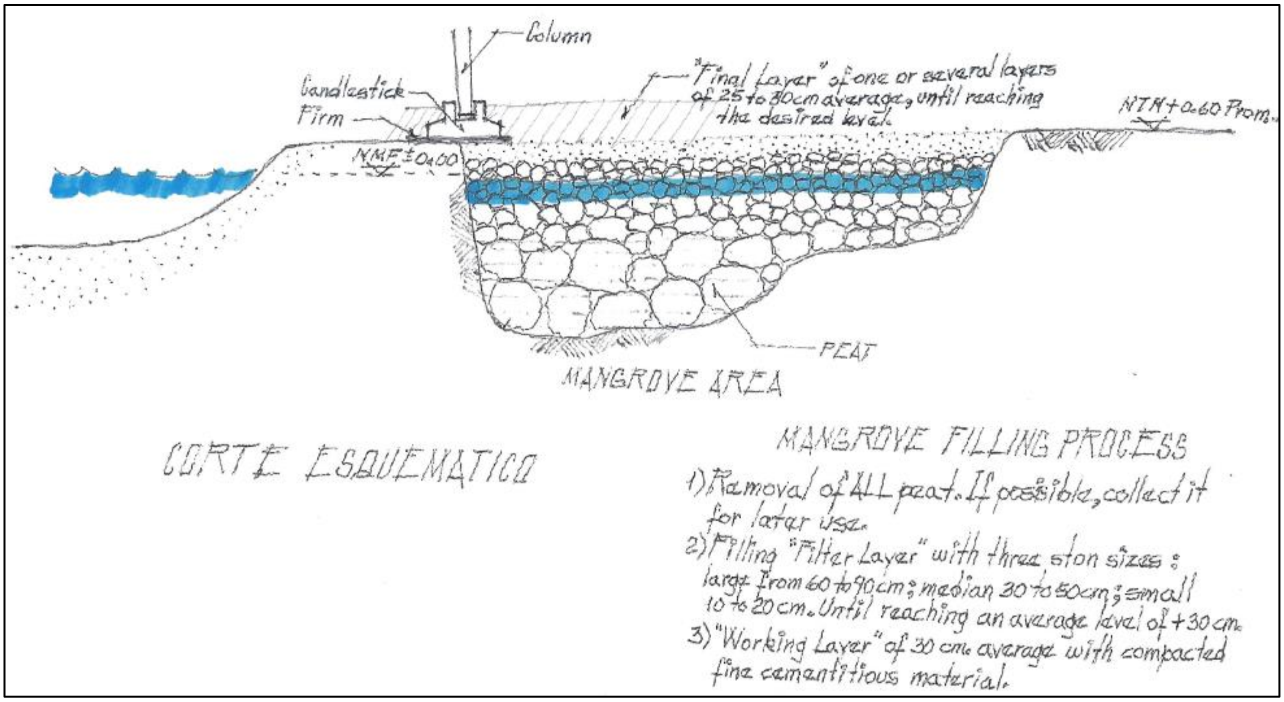


Figure 5-29 Mangrove filling process

5.6.1.2 Foundation

Once the Soil Mechanics Study has been conducted and the Geotechnical Report has been reviewed, the most appropriate foundation system will be determined by the structural engineer. This may involve a Deep Foundation and/or a Superficial Foundation, taking into consideration the condition of the terrain in the area. A Deep Foundation would be pile-based and would only be designated in areas that, according to the soil mechanics study, require it. This process involves drilling guide holes of the necessary size for the placement of the piles. The piles are prefabricated reinforced concrete, made on-site, with dimensions no greater than 45 cm per side and sunk to a depth of no more than 20 m. The exact dimensions will be specified once the soil mechanics study is available. Once the drilling is completed the "ramming" of the piles is done by means of a mechanical "hammer".

After ramming, the piles are "beheaded" in order to integrate them into the Superficial Foundation. The Superficial Foundation may be stripped and/or isolated footing and candlesticks. In the case of Prefabricated Structures; strip footing and counter-beams, for the Room Buildings: 2271 m³ of concrete (in case they cannot be prefabricated), using a traditional construction system of load-bearing walls. In some specific cases, foundation slabs and counter-beams may be used for swimming pools, ponds, and Wastewater Treatment Plant (WWTP).

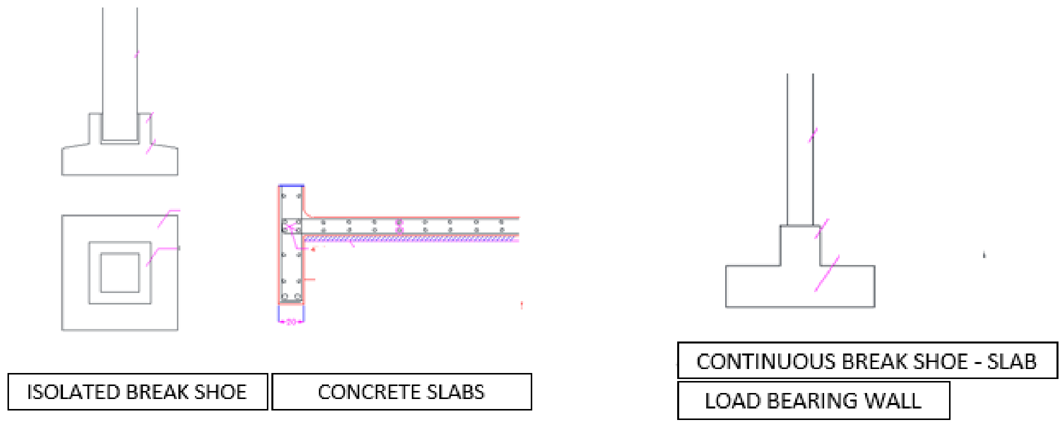


Figure 5-30 Foundation Components

5.6.1.3 Structures

The room buildings will each be four storeys with the exception of the searooms and will be structurally resolved. In cases where they cannot be prefabricated by means of load-bearing walls made of hollow blocks measuring 15x20x40 cm with ladder reinforcements at every third row, reinforced concrete offset chains and reinforced concrete columns of various dimensions which will be "tied" to the block wall every 3 m, reinforced with concrete enclosures and drag beams. The slabs for the mezzanine and roof will be constructed of reinforced concrete and beams using a light concrete as an additional layer in the case of the roof slab, in order to achieve the required slopes.

- **Columns:** 1,859.76 m^3
- **Beams:** 2,595.53 m^3
- **Slabs:** 8,860.78 m^3

TOTAL: 13,316.07 m^3

For prefabricated components, following the procedures outlined in the Section titled *Prefabricated Structures.*

- **Tetra T Slabs:** **4,643.15 m^3**
- **Compression Layer:** **4,290.59 m^3**

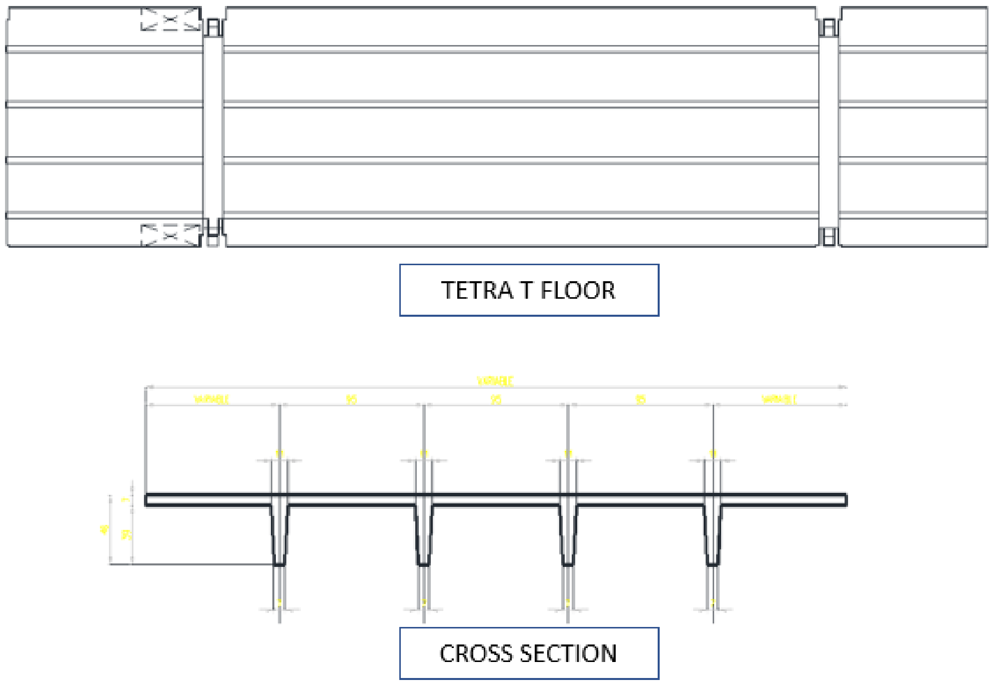


Figure 5-31 Tetra T slabs

For the central building and service areas, a system based on prefabricated pre-forced concrete structures will be used, both in the footings and the columns as well as in the beams and slabs. They will employ a compression layer made of reinforced concrete with electro-welded mesh. This methodology is used in order to achieve a cleaner, more orderly and rapid implementation of the work(s), coupled with greater quality control attained by having all the prefabricated elements made in the plant (on the work site). With regard to the swimming pools, ponds and the Wastewater Treatment Plant, these will be built using reinforced concrete counter beams. The base slab and walls will also be reinforced concrete and in both cases the concrete will have integral waterproofing.

5.6.1.4 Masonry

A cement-sand mortar in a 1:5 ratio will be applied to flatten both the walls and the ceilings with an average thickness of 1.5 cm. The procedure will be as follows; Repelling and masking the walls and ceilings using sifted cement-sand putty to give the final texture. In the bathroom areas, only repelling will be done and then a marble and/or tile-based coating applied to specific areas. Firm levelers will be made prior to the laying of the floors using cement-sand mortar.

5.6.1.5 Covering and Finishes

The floor coverings will be natural stones such as marble, with ceramic floors in certain areas, as will the bathroom coverings. After flattening, a vinyl paint will be applied, and in some cases, a textured acrylic paste applied. The pool area will be lined with Venetian tile affixed with a cement-based tile adhesive and grouted with white-colored cement.

5.6.1.6 Carpentry

The access doors to the rooms and bathrooms as well as the closets will be made of wood. Due to the typical conditions of the region, it will be essential to select the right wood(s) for the climatic conditions and to apply appropriate treatments to repel moisture and pests.

5.6.1.7 Windows and Glass

All windows will be made from aluminum profiles, according to preapproved designs. The glass which will be tempered, laminated, annealed, and screen-printed (decorative). Glasses will be no less than 6mm thick, however, their final thickness will depend on their intended purpose.

5.6.1.8 Drywall and Paint

The false ceilings for indoor areas such as the rooms and the central building will be made of drywall. For outdoor and wet-prone areas, moisture resistant drywall and/or Durock will be used. The drywall will be caulked with joint reinforcement tape and joint compound and then sanded and primed before being painted. In the kitchen area, should a false ceiling be required, this will be removable, fire-resistant, and inflammable.

5.6.1.9 Exterior Works

Pedestrian and vehicular pathways will be built using reinforced and/or stamped concrete, on a 30 cm double-layer base, compacted at 90% PROCTOR. All sanitary modules (work restrooms) will be made of 15-cm-block load-bearing walls, on concrete strip footings and reinforced concrete slabs (except where otherwise indicated). The same will apply for all smaller constructions such as bars, showers and playgrounds.

5.6.1.10 Equipment and Materials

The following equipment will be used for hotel construction:

- CME 55 drilling rigs
- Pile driver
- Benders
- Rod cutters
- Welding Plants
- Platforms for transporting prefabricated parts
- Hydraulic cranes
- Four (4) 110-tonne tucks
- Four (4) 60-tonne trucks

Raw Material and Solid Waste

It is proposed that the aggregate and concrete blocks for the project will be sourced. The excavated material will be stored on site and covered with tarpaulin to minimise dust pollution and bermed to prevent runoff. The construction waste will be collected onsite by a waste disposal company and will be transported to the Retirement Disposal Site in St. James.

5.6.2 Sea Rooms

5.6.2.1 Overview

Another significant feature of the hotel along the coastline is the proposed Sea Room development within the eastern bay. The area proposed for this development is ideal from the point of view that it is naturally sheltered from large waves due to the presence of reefs offshore. The construction of the fourteen (14) Sea Rooms requires the driving of auger piles offshore. This can be done in several ways, but the major limitation is the depth of the nearshore. The water depth in this location is only 0.6m on average and using a barge would not be feasible. The piles will be placed either by driving with a hammer attached to a crane or excavator or by a coring with an auger. A detailed geotechnical survey will be carried out to determine which of these methods is more suitable.

Regardless of the method, a temporary construction pad will be necessary to execute this operation. The construction pad will mimic the same route as the boardwalk. This pad will be made of only granular material below the sea level to minimize introduction of silt within the area. In addition, two culverts (each 15m wide) will be placed along the along the access pad to facilitate flushing. The positive effect of the culverts is to maintain good water circulation in the area. The access pad is anticipated to remain in place for a period of around 6 months and will then be removed, beginning from the seaward-most end. The construction of the super structure for the Sea Rooms will be primarily masonry and carpentry works above sea level. Platforms and scaffolding will be put in place to facilitate this construction (Figure 5-32).

The GPS locations of the central points of each searoom are listed in Table 5-14. The locations are listed for each searoom in a clockwise direction.

Table 5-14 GPS coordinates (JAD2001) of the central points of the searooms listed in a clockwise direction

SEAROOM	EASTINGS (JAD2001)	NORTHINGS (JAD2001)
1	616468.726	696060.506
2	616452.346	696069.532
3	616443.655	696091.929
4	616443.321	696109.645
5	616445.995	696127.362
6	616448.335	696145.413
7	616450.006	696163.130
8	616452.012	696180.847
9	616465.718	696203.912
10	616477.083	696192.213

SEAROOM	EASTINGS (JAD2001)	NORTHINGS (JAD2001)
11	616474.409	696169.147
12	616471.735	696144.745
13	616469.060	696120.677
14	616467.389	696094.937

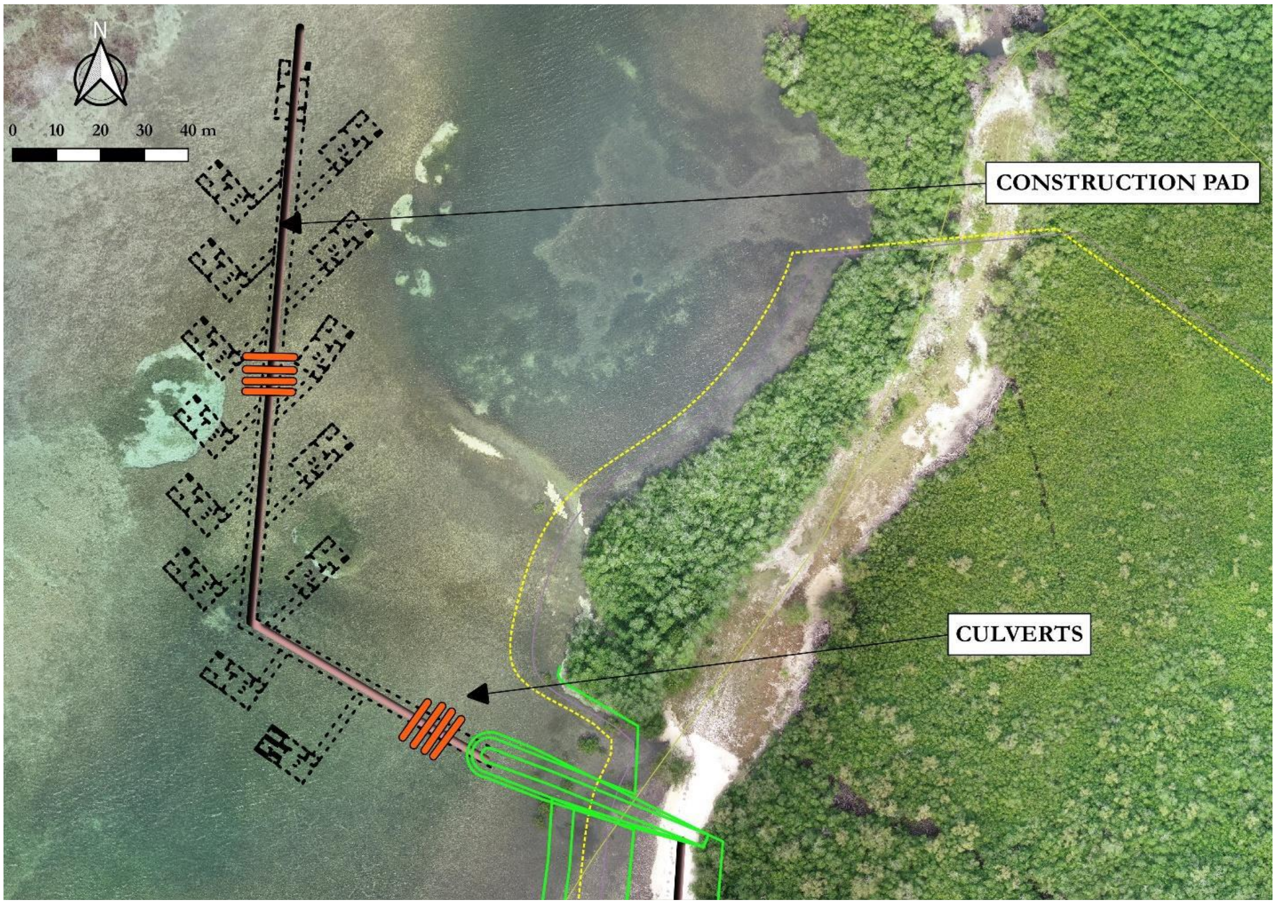


Figure 5-32 Schematic showing the layout of searoom construction pad and culverts

5.6.2.2 Boardwalk

The boardwalk will be constructed of heartwood timber and placed on wooden piles. It will be constructed by using manual labour and no heavy equipment will be used. Only timber piles of solid hardwood, free from decay and insect attack will be used and lumber will be dressed on all sides and shall be free of splits, cracks and defects. Lumber for the decking planks and rail posts shall be dressed and finished on all sides and edges.

5.6.2.3 Equipment and Materials

To complete the proposed searoom construction, the following equipment and materials will be needed:

- Either one (1) hammer attached to crane/excavator **OR** one (1) Auger cast pile rig – for piling installation.
- Two (2) Medium-sized excavators – For removing, loading, placing and handling boulders.
- Two (2) Front end loaders – For loading, removing, placing and transporting material onsite
- One (1) Small Boat – for turbidity barrier management
- Boulders
- Auger cast piles
- Timber pilings and structures

5.6.3 Beach Works

5.6.3.1 Overview

This Section summarizes the document *"Construction Methodology and Specifications for Beach Works and Sea Rooms"* prepared by Smith Warner International Limited.

The resort requires resort-grade beach along several areas of the shoreline to serve the hotel properties. The eastern bay where Hotel 1 is proposed has a natural beach, but its current state requires significant improvement to reach resort standards. The shoreline along Hotel 2 and Hotel 3 is a rocky shore exposed to rough seas daily and, as such, there is no significant natural beach formation. A beach along this area will no doubt require creative intervention. The shoreline at Hotel 3 has a natural sandy beach area but the nearshore is shallow and the seabed is rocky. As such, there is no opportunity for wading. This part of the shoreline is also eroding.

The construction methodology was developed to minimize the environmental impact on the natural habitat, businesses, residences and recreational areas in around the project sites. The following structures will be constructed:

1. Six rock groynes
2. Three rock revetments and perched beaches.
3. One ~1.5m deep flushing channel fortified with two bank revetments
4. One water sports jetty made from concrete armour units.
5. Two submerged breakwaters
6. One emergent breakwater

The expected sequence for the construction of the proposed works is as follows:

1. Seagrass removal;
2. Placement of marine blocks and fish havens;
3. Coral removal and relocation;
4. Creation of access route for equipment;

5. Construction of temporary access road with core stone;
6. Placement of boulders for revetments, groynes and breakwaters;
7. Clearing of rocks from seabed;
8. Placement of sand nourishment to required grade.

Table 5-15 Summary of beach and shoreline works

Activities	*Area of footprint below sea level*	
Hotel 1 • -1.5m MSL flushing channel through western headland • Two groynes at +2m MSL • 500m long nourished sandy beach at a 1:14 slope • 79m of shoreline nourishment with a revetment at +2.8m MSL • +2m MSL groyne to be used as a sport jetty	2049 m^2	*0.5 ac*
Sea Rooms	3300 m^2	*0.81 ac*
Hotels 2 and 3 • Perched beach at +2.8m MSL retained by a revetment at +2.8m MSL • 130m long pocket beach nourished at a 1:14 slope. • Two spur groynes at +3.0m MSL • One submerged breakwater at MSL	2789 m^2	*0.69 ac*
Hotel 4 • Two submerged breakwaters at -0.3m MSL • 450m long nourished sandy beach at a 1:14 slope • One groyne at +2m MSL. • Nearshore dredging of up to 6500m^2	1789 m^2	*0.44 ac*

5.6.3.2 Access Roads and Stockpiling Material

This stage of the construction requires the identification of an access route for the carting of construction material to the site as well as waste material from the construction process. Figure 5-33 shows the construction layout plan for the project, depicting material stockpiling locations, site access roads and construction pad location (for the overwater searooms). From Figure 5-33, the access route will be aligned with the existing entrance for the hotel, then follow the parking lot to the northern pathway that will be converted to a wider roadway, and finally, to the area of the northern boundary will be used also be used for stockpile area. Additionally, the access route will then run parallel to the beach and end at the headland. The stockpile areas will use the green areas along the northern boundary of the site. The stockpile area will be prepared with a suitable working surface of compacted gravel fill. The stockpile area will be used for:

- Site Office
- Storage of Equipment when not in use
- Storage of imported or manufactured sand
- Storage of boulders
- Storage of waste material destined for landfill/disposal facility
- Drainage area of excavated material

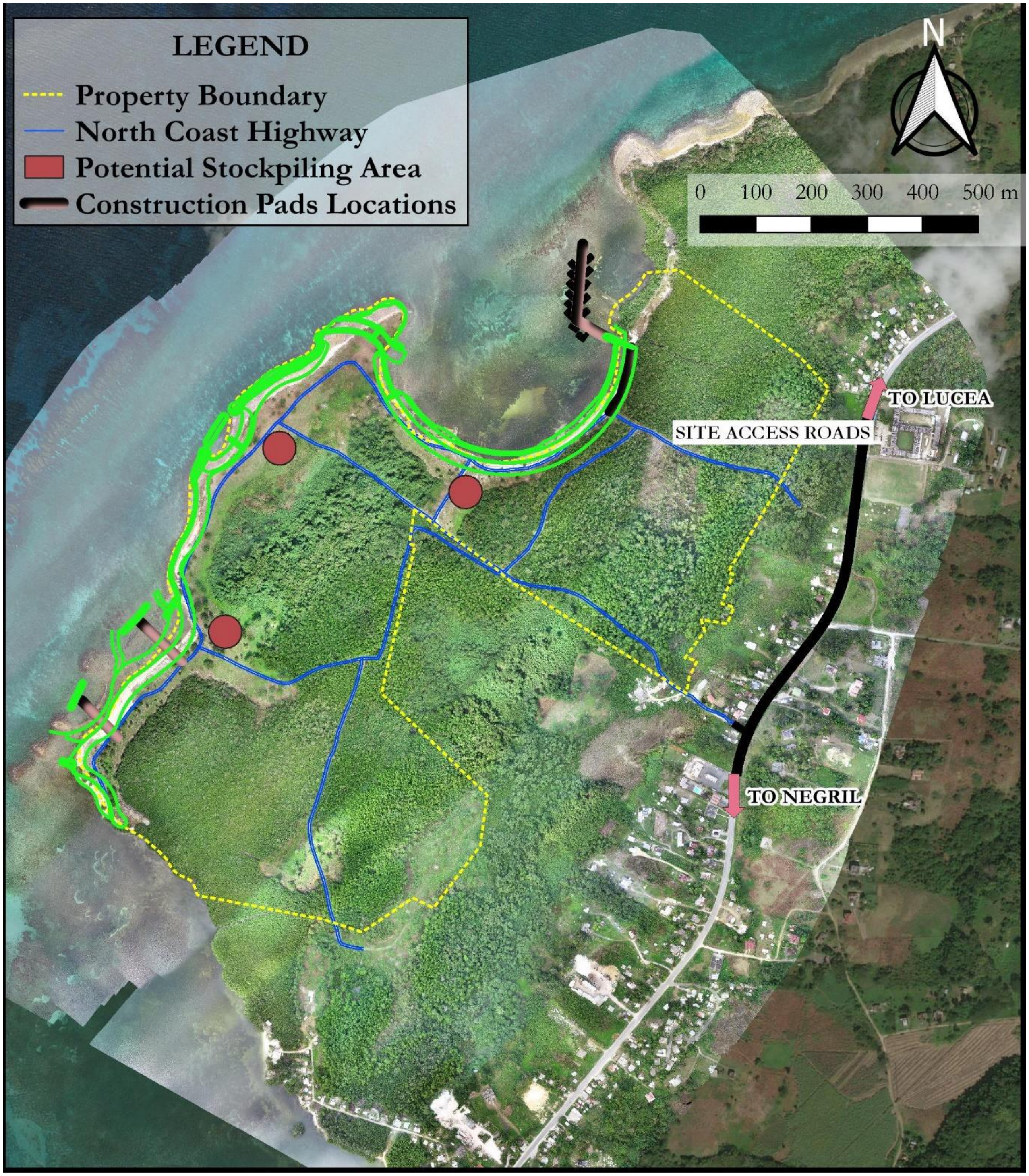


Figure 5-33 Construction Layout showing material stockpiling areas on site and construction pad location (for searooms)

5.6.3.3 Groyne, Breakwater and Revetment Construction

Generally, boulders will be placed according to the design. For this process, an excavator will be used to progressively place the boulders from shore. The armour units will be placed on the existing grade without excavation of the seabed. The rocks will first be placed to an elevation suitable for moving the equipment from land to the extents of the works. When returning, rock structures will be shaped and brought to the required elevation by either removing the rock layers or adding addition layers to meet design requirements.

For the revetment along Negro Point, an access road will be constructed to run along the back of the beach to access the headland of Negro Point. The revetment will be placed using the excavator from land.

Specifically, for groynes, spotters in the water will assist the heavy equipment in accurate placement of the amour units. The slopes and elevations of the armour layer will be demarcated with visual aids to guide the placement of boulders and to ensure that they are properly interlocked.

The method of placement of boulders will be such that the natural shape is utilized as best as possible and interlock against each other, void free and neat along the lines and grades of the structure without damaging the filter fabric in any form. The filter fabric should not become torn or damaged otherwise. Any sections of the filter fabric damaged during the installation of armour stones will be replaced. The finished surface of the structures will be of uniform appearance and free of cavities, mounds, depressions, wind rows and other surface undulations. Any variation in finished line, grade or slope within the allowable tolerances below shall not be constant over an area greater than 10 m^2 and shall transition smoothly and gradually into adjacent areas. The finished surface is to be neither uniformly high nor uniformly low within the tolerances: (vertically ±300 mm; horizontally ±1000 mm). The finished elevation of the structures below High Water Level shall be done within a tolerance of +/- 0.2m of the design elevation and finished elevations above High Water Level shall be within +/- 0.3m of the design elevations. The desired look for structures packed above MSL, particularly groynes and revetments is shown in Plate 5-8 below.

Plate 5-8 Example of finished look of groyne/revetment.

5.6.3.4 Dredging the Foreshore

A bucket excavator will be used for dredging the seabed. To do this, boulders will be used as a construction pad in areas too soft for the excavators. The excavated material will be carted to the proposed stockpile area for the drainage. The boulders used for the construction pad will then be removed. The foreshore will be mechanically dredged (by excavator) and then hydraulically dredged (suction pump).

5.6.3.5 Dredge Spoil Drainage

The material dredged from the beach area will be brought to the stockpile area with trucks and/or discharge pipes. The material will be dewatered in a settling pond constructed in the same area as the stockpile. After the dewatering of the dredge spoil is complete, the suitable material will be used for back fill of the back of the beach and the filling behind the Negro Point Revetment.

Excavated material that is placed on land must be allowed to dry out substantially before transportation to approved disposal areas, if dumping is necessary. Where settling ponds are used, the ponds shall have adequate capacity to minimize downtime during clearing of these ponds. Run off from excavated material shall be controlled so as to minimize erosion of the shoreline or introduction of turbidity into the marine environment

5.6.3.6 Sand Nourishment

The imported (Bahamas) or manufactured sand will be placed and sloped to required grade in the cleared area. The sloping will be done by using a front-end loader and finally smoothed manually by labourers.

5.6.3.7 Cove Beach Construction

The area will be excavated using an excavator. A bucket excavator will be used for dredging/excavating the seabed. The excavated material will be carted to the proposed stockpile area for drainage. The foreshore will be mechanically dredged (by excavator) and then hydraulically dredged (by suction pump). A construction pad made from boulders will also be used to the construct the emergent breakwaters. The rocks will first be placed to an elevation suitable for moving the equipment from land to the extents of the works. When returning to land, rock structures will be shaped and brought to the required elevation by either removing the rock layers or adding addition layers to meet design requirements. The sand (imported or manufactured) will be then placed and sloped to required grade in the cove created. The sloping will be done by using a front-end loader and finally smoothed manually by labourers.

5.6.3.8 Flushing Channel

An excavator with a hammer will be used to create the flushing channel. Once the channel is excavated and sloped according to design, filter fabric and armour rocks will then be used to create the bank revetments.

5.6.3.9 Water Sports Jetty

Concrete units will be constructed at the stockpile area. The excavator will then be used to place the concrete units. The revetment structures will be shaped and brought to the required elevation by either removing the rock layers or adding additional layers to meet design requirements.

5.6.3.10 Turbidity Monitoring

Turbidity barriers will be used around all works occurring in the marine environment to minimize leakage of silty material to ecologically sensitive areas. Turbidity will also be monitored daily at two locations of each work area where there is construction (or as per NEPA permit). Where turbidity measurements surpass NEPA standards due to any marine construction, work will stop until normal conditions recover, as per NEPA permit. The turbidity barriers shall be deployed and anchored in accordance with manufacturer's instructions to surround any and all areas where construction works will create turbidity in the marine environment. All necessary measures will be taken to ensure that the barrier is maintained in position during the work and is effective in retaining all suspended sediment and debris. The Contractor will remove trapped floating debris as required to ensure proper functioning of the barrier. The height of the barriers shall cover at least 60% of the deployment depth up to a maximum height of 3.0m, unless the conditions at the site dictate otherwise to ensure that all suspended sediments are effectively contained. The turbidity barrier shall have the appropriate floats, weights and anchorage system to allow for adequate containment of turbidity.

5.6.3.11 Miscellaneous

The Contractor will monitor marine weather and forecasts and shall take appropriate measures to protect the works and his equipment in the event of unfavourable forecasts particularly with regard to tropical storms or hurricanes as well as taking account of usual/normal weather conditions at the site during the season of the work and make adequate allowance for normal bad weather in establishing work schedules and procedures. All equipment fuelling must be performed inshore from the high water line on concrete pads. The Contractor will protect all surfaces from any accidental spills that could occur during fuelling and shall put in place and execute contingency plans to contain and clean-up any accidental spill that may occur.

5.6.3.12 Equipment and Materials

To complete the proposed beach and shoreline works, the following equipment and materials will be needed:

- Two (2) Medium-sized excavators – For removing, loading, placing and handling boulders, fill, sand and other materials
- Two (2) Front end loaders – For loading, removing, placing and transporting material onsite
- Two (2) Hydraulic Suction Dredge Pump Assembles - for clearing of silty areas and hydraulic removal and transport of sandy/silty material
- One (1) Cement Mixer – to mix concrete
- One (1) Small Boat – turbidity barrier management
- Trucks – for material transport
- Boulders
- Sand sourced from either manufactured, dredged or imported sand source.
- Fill material
- Filter fabric/Geotextile

5.7 PROJECT PHASING AND SCHEDULING

The construction of the first phase is anticipated to take 18 – 24 months after which there will be a 1-year break and the construction of the second phase will commence with that phase anticipated to take an additional 18 – 24 months.

- Phase 1
  - Hotel 1 (adults only) – 422 rooms
  - Hotel 2 (family resort) – 590 rooms

    Total Rooms - 1,012 rooms

- Phase 2
  - Hotel 3 (family resort) – 590 rooms
  - Hotel 4 (adults only) – 435 rooms

    Total Rooms – 1,025 rooms

5.8 OPERATION

5.8.1 Employment

Once fully operational (Phase I and II), Princess Hotels and Resorts expects to employ approximately 2,852 persons (phase I – 1,417 pers. and Phase II – 1,435 pers). The expected staffing for the operational phase of approximately 2,582 persons should result in approximately 4,763 indirect and 1,797 induced jobs.

5.8.2 Energy Conservation Strategies

Jamaica has one of the highest electricity rates in the Caribbean, and hotels are generally energy intensive. The proposed Princess Hotels and Resorts will incorporate several energy saving practices and technology to conserve on energy use and reduce costs. These will include:

- All rooms will be lit by Light Emitting Diodes (LED) technology.
- The other areas of the hotel will be LED type or low power consumption CFL (Compact Fluorescent Lamp).
- In every room there will be sensors that cut off the supply of air conditioning and some electrical circuits in the room when no detected any presence.
- The room air conditioning will be stopped in the event of a window/patio door opening although the sensor might indicate a presence.
- All air conditioning pipe will be coated with 1 inch of thermal insulation to reduce heat loss and therefore more efficient operation of the air conditioner.

5.8.3 Water Conservation Strategies

Jamaica over the years have been experiencing water shortages especially during the summer months due to droughts. This has become more acute as the years pass by; therefore, water conservation strategies have become more critical.

This Project has incorporated water conservation features with the use of low consumption equipment. These include:

- Dual flush toilets with half (0.8 us gals) and full flush (1.6 us gals). This compares well with toilets in the 1980s that used approximately 3.5 us gals or traditional ones that used up to approximately 7 us gals.
- The faucets that will be used have water reducer (aerators) incorporated. This has the effect of restricting the maximum flow rate from the faucet. Typically, low flow bathroom faucets range from 0.5 – 1.5 us gpm (1.9 – 5.7 l/min).

In addition to these conservation features, treated wastewater effluent from the wastewater treatment plant will be used for irrigation around the property. This will result in a reduction in the water demand of the new hotel.

5.9 DECOMMISSIONING

At the time of decommissioning, the following activities will aim to satisfy the health, safety and environmental issues associated with the closing of the construction site in a manner which mitigates any adverse environmental impact.

1. Advanced notification (2 weeks) to relevant local authorities (NEPA, Hanover Municipal Corporation) of near completion of construction and potential change in status of the site.
2. Final notification to relevant local authorities (NEPA, Hanover Municipal Corporation) of completion of construction and change in status of the site to that of an operational hotel resort.
3. Notification to property neighbours and the immediate surrounding Green Island residential community will occur 1 week before decommissioning activities commence.
4. Security personnel will be present at all times, as it would be during normal construction phase until the decommissioning has been completed. Signage will be clearly posted at the entrance of the facility alerting the public that the facility is “Closed” and the area is “Restricted.”
5. Vehicular and pedestrian access will be restricted to only personnel necessary to carry out the activities associated with decommissioning activities. Flag persons will continue to remain at the entrance to regulate any heavy equipment entering or exiting the site as during the construction period.
6. All access will be via the posted security personnel and recorded in the security log.
7. All equipment and material used during construction will be removed from the site. This will include the boulders acting as a temporary access road to construct the overwater rooms as well as all debris and equipment in the marine environment used in the searoom construction process (anchors, debris, rebar, scrap metal etc.)
8. Administrative office structures will be transported off the property (no permanent structures would be constructed)
9. Portable toilets and hand wash facility leased would expire and returned to the operator
10. All material stockpiles will be utilized in the construction process and the remainder removed from the site.
11. All solid waste and debris on site and in the marine environment will be removed and disposed of by licenced contracted municipal waste operators at an approved disposal site.

The estimated timeline for decommissioning activities is 1-2 months after each construction Phase (Phase I and II) is completed.

6.0 DESCRIPTION OF THE ENVIRONMENT

6.1 PHYSICAL ENVIRONMENT

6.1.1 Climate and Meteorology

6.1.1.1 Weather Station Data

Temperature, relative humidity, rainfall, wind speed and direction and barometric pressure were recorded over forty-eight (48) hours (Tuesday August 13th to Thursday August 15th, 2019) setup on the proposed project site, by using a Davis Instruments wireless Vantage Pro2 weather system with a data logger and a complete system shelter erected on a tripod. Data were collected every fifteen minutes and stored on the data logger. This information was downloaded using the WeatherLink 6.0 software.

The following were the summarized results of the assessment:

- Average temperature recorded was 27.27°C and ranged from a low of 22.4°C to a high of 33.2°C.
- Average relative humidity was 88.4% and ranged from a low of 68% to a high of 98%.
- Average rainfall was 1.02 mm over six (6) rain days and ranged from a low of 0.25mm – 3.05 mm.
- Average wind speed was 0.2 m/s and ranged from a low of 0 m/s to a high of 4.0 m/s.
- Dominant wind direction was from the northwest.
- Barometric pressure ranged from a low of 1012.9 millibar to 1018.0 millibar.

6.1.1.2 Historical Long-Term Wind Data for Negril

The following excerpt was taken from the "Environmental Impact Assessment for the Construction of Two Breakwaters at Long Bay, Negril, 2014"

The NOAA long term wind wave data model was searched for long term wind data for Negril. A node was chosen in front of the bay and the wind data corresponding to that node obtained. The node used was Latitude 18- 18.58N, Longitude 078-27.59W.

The data spanned the years of 1999 to 2007 recorded on a daily basis at three-hour intervals. The data is shown in a wind rose in Figure 6-1. The data was analysed in terms of percentage occurrence of various wind speed and direction combinations in order to characterize the wind climate for the site.

The analysis revealed that the winds have directions predominantly of NE to E direction with wind speeds of 20 m/s or less approximately. North to North West and southerly wind directions were noted to occur but rarely. Overall the average wind speed and direction is between 2 to 4m/s from the ENE.

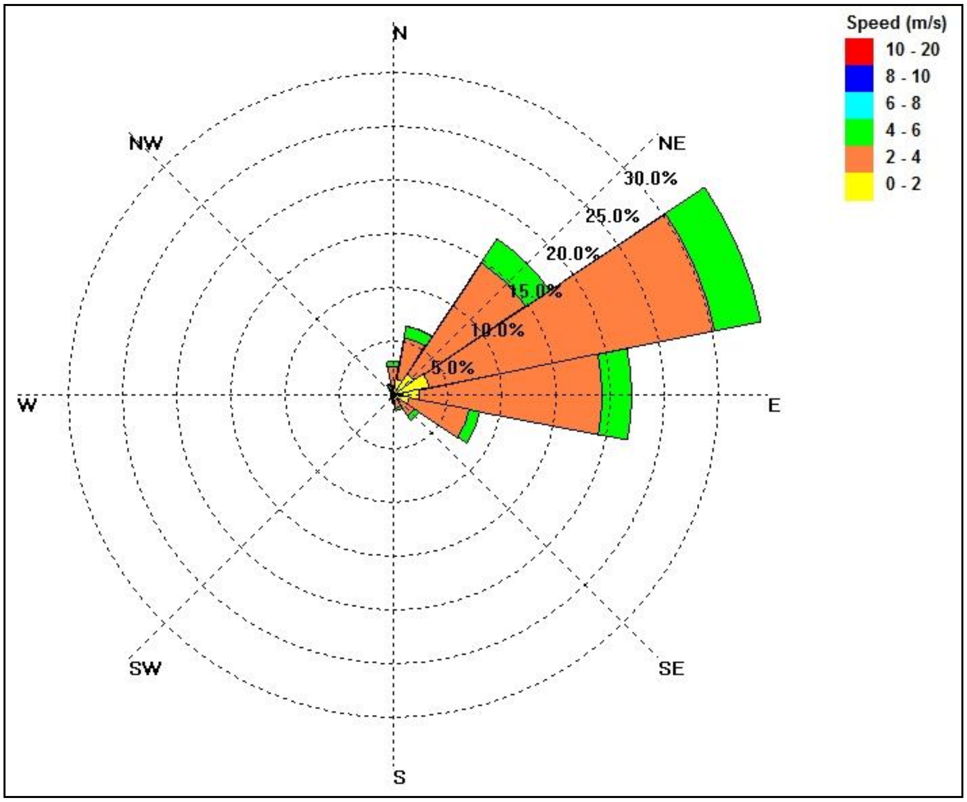


Figure 6-1 NOAA Long Term wind data for Negril offshore node, spanning 1999-2007

6.1.2 Topography

This section describes the terrestrial elevation from profiles and digital elevation model (DEM) data.

6.1.2.1 Method

A topographic survey of the mangrove forest was conducted via theodolite survey. An Unmanned Aerial Vehicle (UAV) was used to collect data of the ground elevation of sections of the bay. The data was limited to only areas where there was a clearing in the mangrove forest.

6.1.2.2 Results

The topographic surveys provide supporting evidence for the theory that roadways act as physical impediments for tidal influence of the whole forest. Figure 6-2 shows that the NW sections of the forest have an identical elevation (+0.25m MSL) to the mangrove forest areas surveyed south of the access roadway, as close to the freshwater transition zone. A similar occurrence is found in the NE forest (Figure 6-3). A 0.20m elevation is found at the eastern canal area, throughout most of the forest and all the way south close to the community. However, no saltwater was recorded in the mid-south area of the forest (yellow circles).

Figure 6-2 Western mangrove topography with proposed drainage ponds

Figure 6-3 Topography at eastern section of property, highlighting identical elevations in mangrove forest (yellow circles)

The total catchment area was delineated using the 1:2500 topographic map for the area and was found to be approximately 2.32km². The terrain of the site is generally flat from the shoreline to the A1 highway after which it rises with slopes varying between 10% and 18%. Using Google Earth, the approximate developed area within this site was estimated to be 0.23km² or 9.92% of the total catchment area as depicted in Figure 6-4 below. Such development was noted to be along the A1 Road primarily.

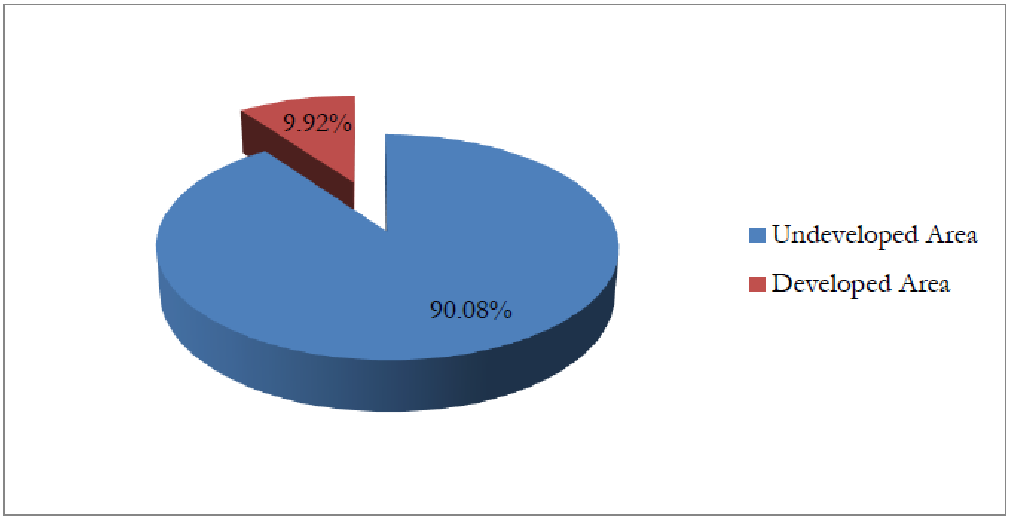


Figure 6-4 Land use distribution of existing catchment area

6.1.3 Geomorphology

The landscape between Green Island Harbour and Davis Cove consists in broad lines of a shallow depression occupied by mangroves, bordered on the seaward side by a low narrow coastal ridge and on the landward side by an incised erosional plateau which rises gradually over a distance of 200m to a height of approximately 20 to 30 m.

The coastal ridge consists within the property boundaries of bare coral reef, coral rubble and calcareous sands. It has an average height of 0.75m and an average width of 40m. The ridge reaches a maximum height of 1.5 m and a maximum width of 130m in the north-eastern half of the property and ends in the west in a small cove (Negro Bay) (Figure 6-7).

The cove is very shallow. It is about 1 to 1.5 metres deep and has a maximum depth of approximately 2m. Analysis of 2001 1m resolution satellite imagery compared with 2019 orthomosaic imagery collected with a drone indicates that the coastline of the cove has significantly been eroding. The southern edge of the cove appears to have receded between 25 to 30m (Figure 6-5). Coastal erosion is also taking place on the opposite side near Green Island harbour close to the western corner of the property. Over the same period 20 to 25m of the coast has been lost there to the sea (Figure 6-6).

The mangrove area behind the coastal ridge is roughly at sea level. The mangrove canopy is closed and there are no open water surfaces. Except for filled in access roads the mangrove area is completely waterlogged but the water in the mangrove appears to be very shallow. The water depth in the areas that were accessible was in the order of 30 to 50cm. Within the mangrove area there is one distinct drainage channel; a tidal creek with a visible surface water connection is one distinct drainage channel, a tidal creek with the sea. a visible surface water connection with the sea. A few channels have been cut through the mangroves in an attempt to provide drainage for the morass. One can be seen in the northern section of the property and is linked to a culvert at the northern boundary of the Green Island High schools and another one begins in near the edge of the open area in the southern section of the property and ends outside the property in Green Island Harbour. None of these channels appear to be effective outside periods of heavy, persistent rainfall.

No continuous flowing streams are discharging into the morass. Most of the surface runoff of the hinterland immediately above the Coastal Highway flows either toward the Pell River which exits into Green Island Harbour or to the Lookout River which discharges into Davis Cove. Only a very small area above the Negril main road is actually draining into the morass. The boundary of that small drainage basin is shown in Figure 6-7. The main drainage channel of the area reaches the morass through a culvert 250m south of the Green Island High School but disappear as the channel enters the mangrove. Considering that there are no obvious channels or streams connecting the mangrove area to the sea, is expected that much of the runoff discharges as submarine seepage or offshore springs into the sea. A significant amount of the water is probably also released to the atmosphere through evapotranspiration processes in the wetland.

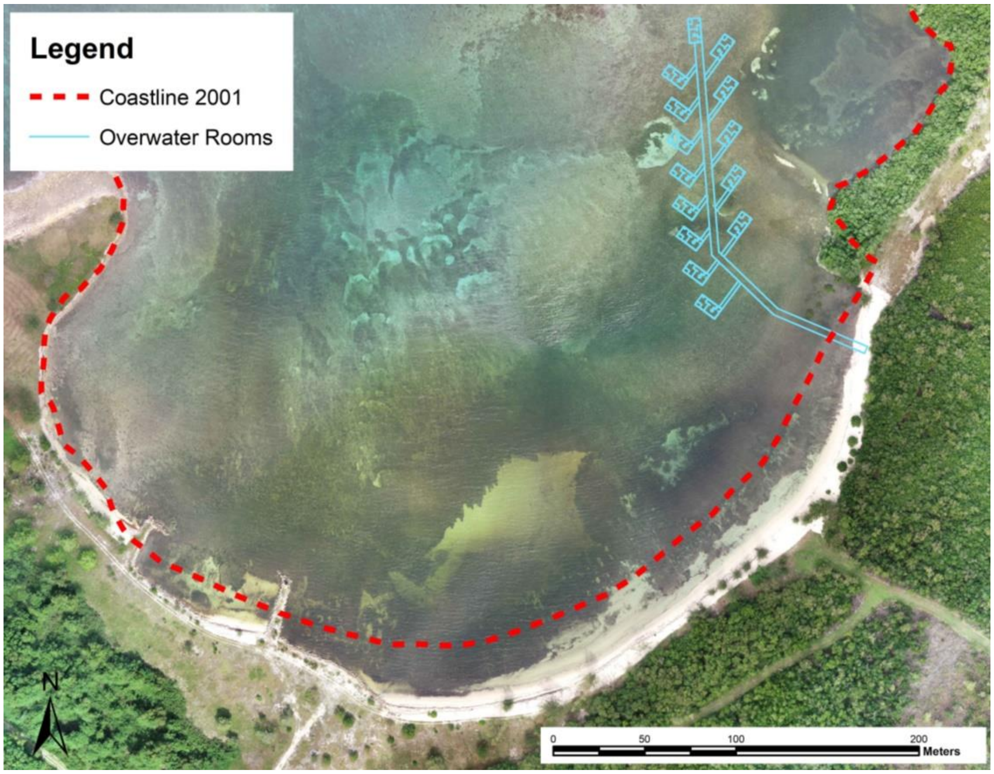


Figure 6-5 Coastal Erosion 2001 to 2019 Eastern section of the property (Negro Bay)

Figure 6-6 Coastal Erosion 2001 to 2019 Western section of the property (Green Island)

Figure 6-7 Topography and Hydrology

6.1.4 Soils

The soils map in Figure 6-8 is adapted from Hanover Soil map (Price, 1960). The soil map of Hanover identifies only two units within boundaries of the property, the Carron Hall Clay and the Mangrove Swamps. The Carron Hall Clay (94) is only present on the very edge of the property, where it abuts the Negril main road. The Carron Hall Clay is a stony, shallow well-drained soil of good natural fertility which develops over rubbly limestone and marls.

Except for that tiny area of The Carron Hall Clay, the entire property is identified by the Hanover Soil map as Mangrove Swamps, which is strictly spoken not a soil type but a land type. The area mapped as Mangrove Swamps includes several other soil type or land types. The coastal ridge which is quite visible on satellite imagery and aerial photos is not recognized on the 1960 soil map as Coastal Beaches and Coral Rock (C) unlike the coastal area to the North of Negro Bay. The extent of the beaches and coral rocks and areas that have been filled-in recently with calcareous gravels and marls are marked in Figure 6-8 with a yellow cross hatch pattern. 1961 aerial photography also shows that sections of the area mapped as mangrove swamps have been used for mixed agriculture and for sugarcane.

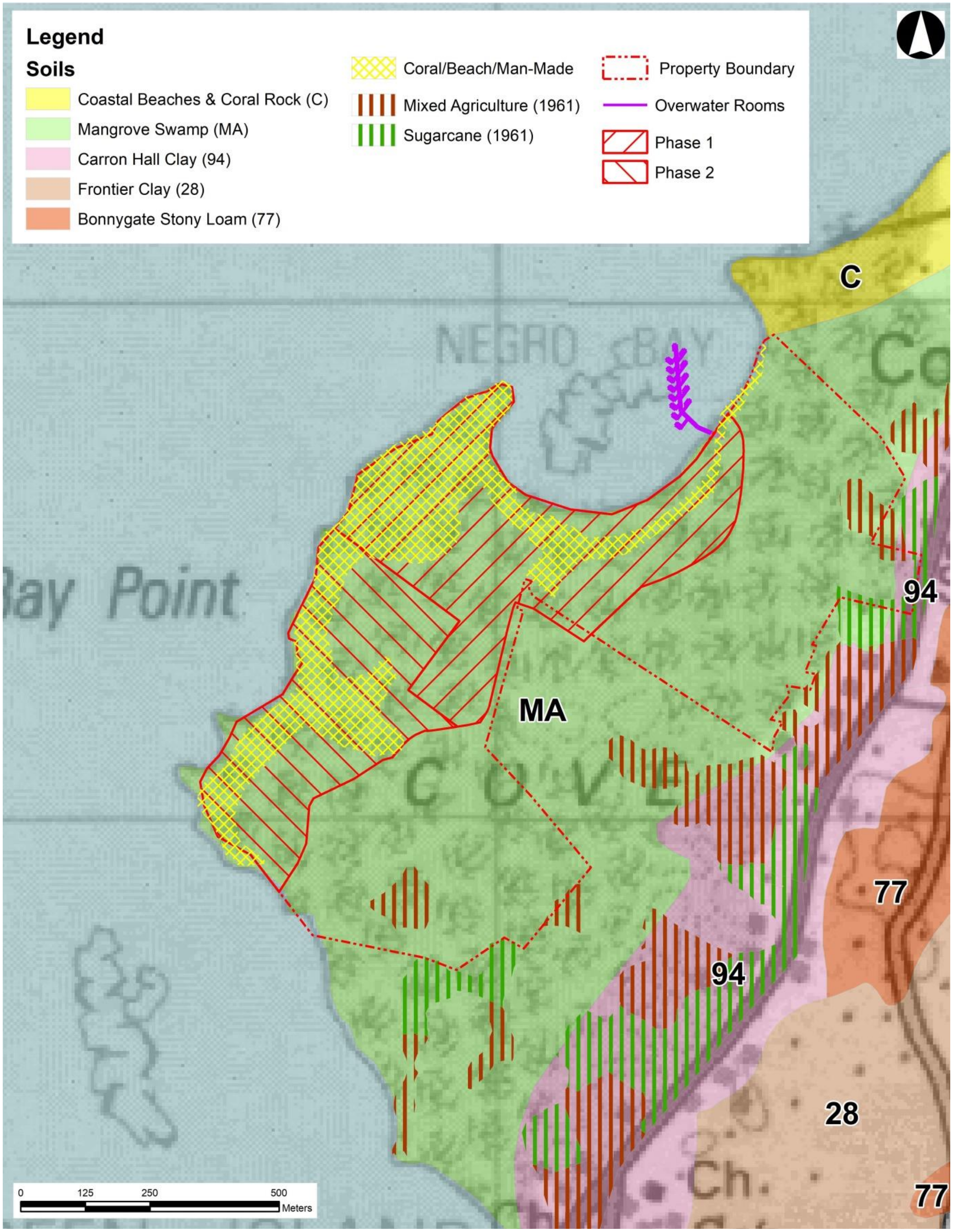


Figure 6-8 Soils Map (Adapted from Price R.W. (1960)

6.1.5 Geology & Geotechnical Aspects

The geology map in Figure 6-9 is adapted from the Mines and Geology Division Geological Map Series Sheet 1 (Mines and Geology Division, n.d.) and from (Grippi, 1978). It shows the Coastal Limestone (Mp) as the only formation exposed within the property. The Coastal Limestone is generally defined as an agglomerate of loose, rubble marls, clays, limestone fragment and coral heads. The Coastal Limestone appears to have been unconformably deposited in this area over the Yellow Limestone formation (Ech). The contact between the Coastal Limestone and the Yellow Limestone coincides roughly with the location of the Negril main road to the east of the project area. The Yellow Limestone formation (Ech), exposed in the first terrace level above the road consists of fossiliferous limestones ranging from wackestone to packstones with variable quantities of clay-grade impurities which causes the limestone to weather to a yellowish or brownish colour,

A total of 49 borehole have been drilled by Horizon Construction Jamaica Ltd (Horizon Construction Jamaica Limited , 2019) in the footprint of the phase 1 resort building to a depth varying between 30 to 117ft (9 and 36m) below the surface to determine the geotechnical characteristic of underlying deposits.

Groundwater was encountered in all boreholes at the depth below the surface equivalent to the height above sea-level of the borehole. In other words, the drilling confirmed that the groundwater below the site is at sea level and this expected to be so over the entire property.

Peat was encountered near the surface in most of the boreholes, varying in thickness from 3.5 to 14ft (0.9 to 4.3m). The peat layer is thickest along the south eastern edge of the cove where the peat layer is 9 to 14ft thick. The boreholes located on the coastal ridge to the south east of the cove were free of peat but on the landward side of the ridge the peat deposit of substantial thickness were encountered (Figure 6-9).

Under the Peat deposits the borehole records describes limestone deposits of various densities and compositions. A very dense layer of the coralline limestone of 5 to 25 feet (1.5 to 7.5m) thick is underlying the peat deposits at depths of 5 to 15 feet (1.5 to 4.5m). This layer is followed in by alternating layer of loose to very dense deposits which are classified in the geotechnical report as fine to coarse silty sand with gravel (SM), silty gravel with sand (GM), poorly graded gravel with silt and sand (GP-GM), and clayey gravel with sand (GC). In most of the boreholes limestone deposits with higher clay content and a yellow to orange colour appear at depth of 50ft (15m).

The peat deposits and the loose layers of calcareous deposits with very low STP-N counts and which may be associated with porous zones linked to the groundwater flow do pose significant problem for the stability of proposed development. To remedy the bearing capacity of these deposits Horizon Construction Jamaica Ltd. recommends the implementation of three different foundation solutions to match the existing soil conditions. Figure 6-10 shows where these three solutions should be used.

<u>1 Soil removal and replacement</u> where highly compressible soils (Peat) are present near or at the surface. The existing soft material will be removed and replaced with compacted gravel fill.

2 Soil removal and replacement and PICRI in areas where zones of soft/porous material or cavities were detected below the surface in the limestone deposits. Pressure Injection Concrete Rigid Inclusion (PICRI) are unreinforced, grouted or concrete columns installed in very soft soils to meet settlement criteria and improve bearing capacity for support of shallow foundations of a structure. A hollow stem auger is drilled up to a specific depth or until a certain criterion is reached. While the auger is retracted, pressure concrete is injected through the hollow stem of the auger at a continuous and controlled rate. The ground improvement by concrete columns will mitigate liquefaction and lateral spread, improve the bearing capacity, limit the settlement of the shallow foundations and fill up voids and cavities that may exist.

Continuous Flight Auger (CFA) Piles are recommended for the areas to the southeast of the cove where the peat deposit are very thick and firm deposit are very deep. Continuous flight augering (CFA) is a technique to create a deep foundation with cast-in-place concrete piles. A continuous flight hollow stem auger drill is used to excavate a hole in soil or rock to the design depth, When the auger is removed, Concrete or grout is pumped through the hollow stem while the auger is pulled out. Reinforcement is inserted into the wet grout or concrete after the auger is removed.

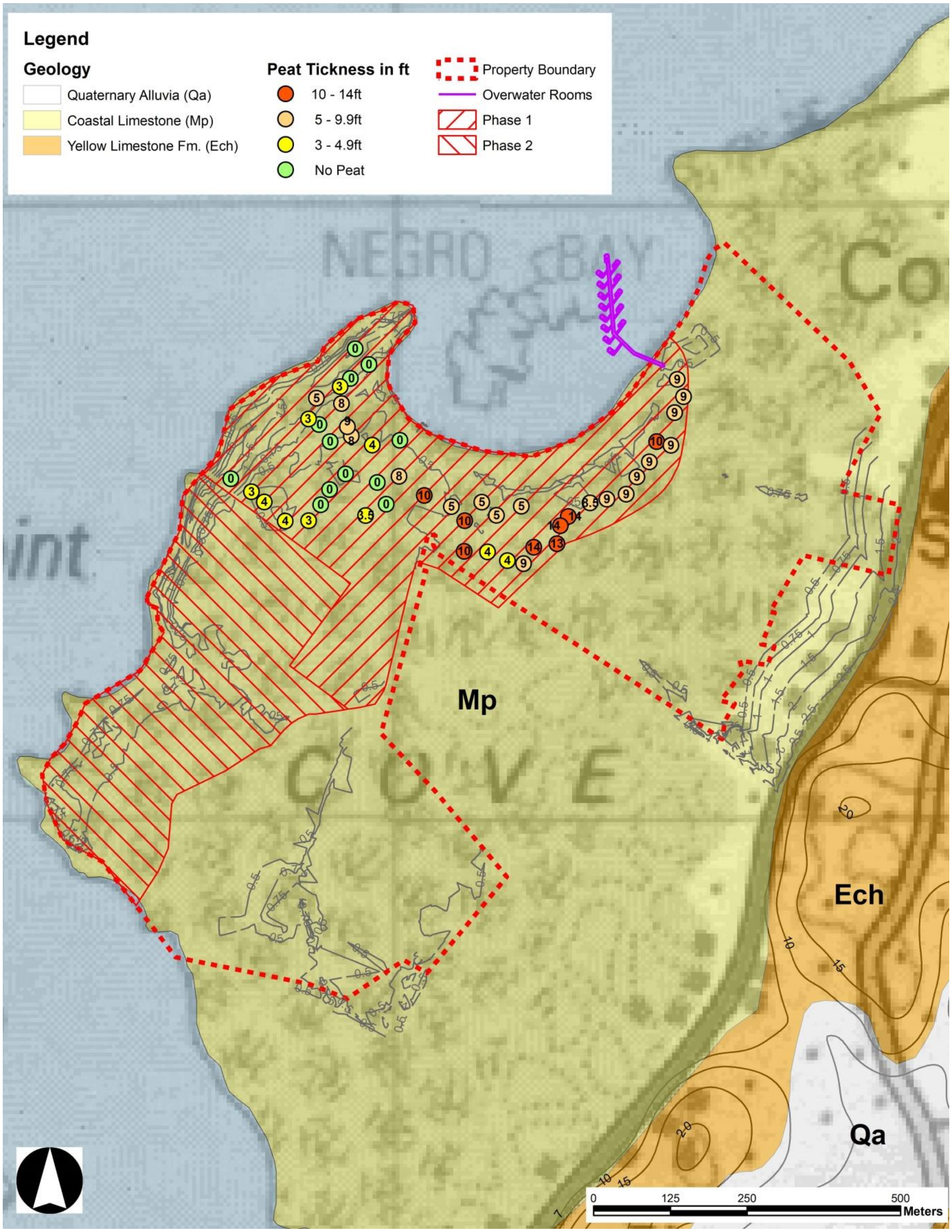


Figure 6-9 Geology of the Project Area (adapted from MGD Metric 1:50,000 Geological Map Series Sheet 1 and Grippi (1978) and Thickness of Peat from the borehole records of Horizon Construction Ltd (2019)

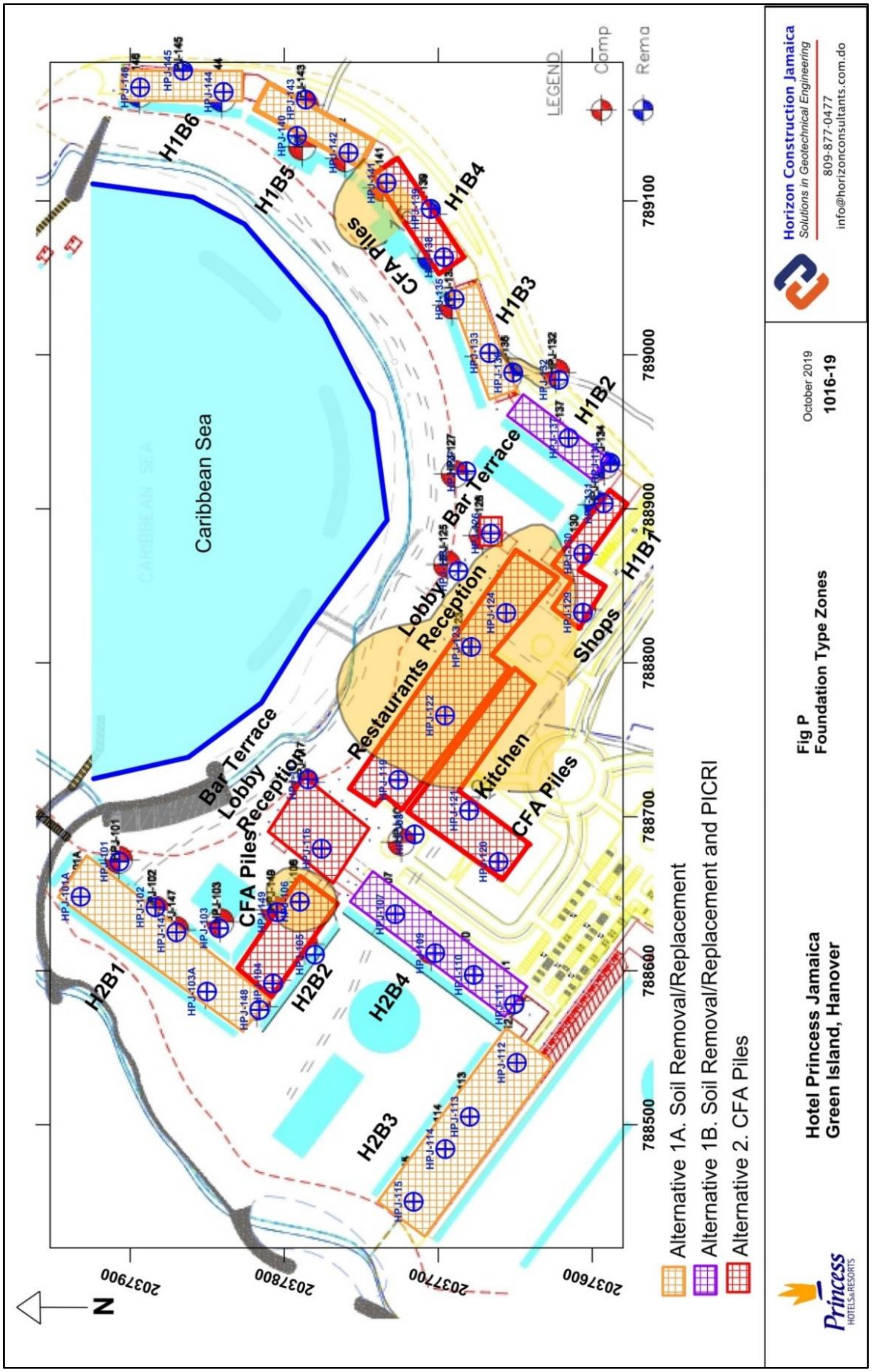


Figure 6-10 Foundation Recommendations by Horizon Construction Jamaica Ltd

6.1.6 Drainage and Hydrology

Smith Warner International Limited conducted a detailed drainage design plan for the proposed project. The following section presents some of the main findings from the associated report regarding existing drainage conditions.

The detailed **"Master Drainage Plan Design Report"** is submitted as a standalone report document.

6.1.6.1 Pre-Development Flood Levels

The proposed project site gently slopes from elevations ranging from 2.5m to 0.5m above mean sea level (MSL) down towards the mangrove forest, which lies around 0 to 0.2m MSL. This wetland is also located downstream of a wider catchment area that drains into it. Hence, the mangrove forest acts as a natural retention system during low flows, storing runoff to nourish the flora within it. Pre-development site flood levels in the mangrove are shown in Table 6-1.

Table 6-1 Pre-development flood levels

Storm Event	Pre-Development Flood Levels (m MSL)
2 year	0.35
5 year	0.49
10 year	0.573
25 year	0.62
50 year	0.747
100 year	0.836

6.1.6.2 Flow Paths

The extent of the wetland displays a complex hydrological regime with the eastern and western sections strongly influenced by tides, southern areas being primarily riverine and some mid-sections having mixed/estuarine properties. Water originating from the highway to the south travels in a northern direction to the northern wetland extent, diverting to two main eastern and western tidal exchange points, and mixing with saltwater in some eastern and western sections of the forest.

Five (5) culverts were identified along the highway draining north towards the wetland (Figure 6-11). A very large and actively flowing culvert (culvert #5) (Plate 6-1) was observed at the eastern extent of the road. This is the culvert which likely supplies the eastern area with fresh water and results in a heavy outflow through the service road culvert, towards the eastern mangrove.

The physical barriers created by the roadways in the wetland area are likely preventing more widespread mixing of fresh and saltwater in some segregated forest sections. Brackish waters were recorded in areas closer to the eastern and western tidal influence, but minimal saltwater influence was detected/recorded in the mid and southern sections of the forest, despite being only a few meters away from tidal occurrence areas, being separated by limestone and/or earthen roadways. Figure 6-12 summarizes the observed hydrology flows on property.

Figure 6-11 Culvert locations on highway and important drainage features on property

Plate 6-1 Culvert #5 -main supply of fresh water to eastern end of property

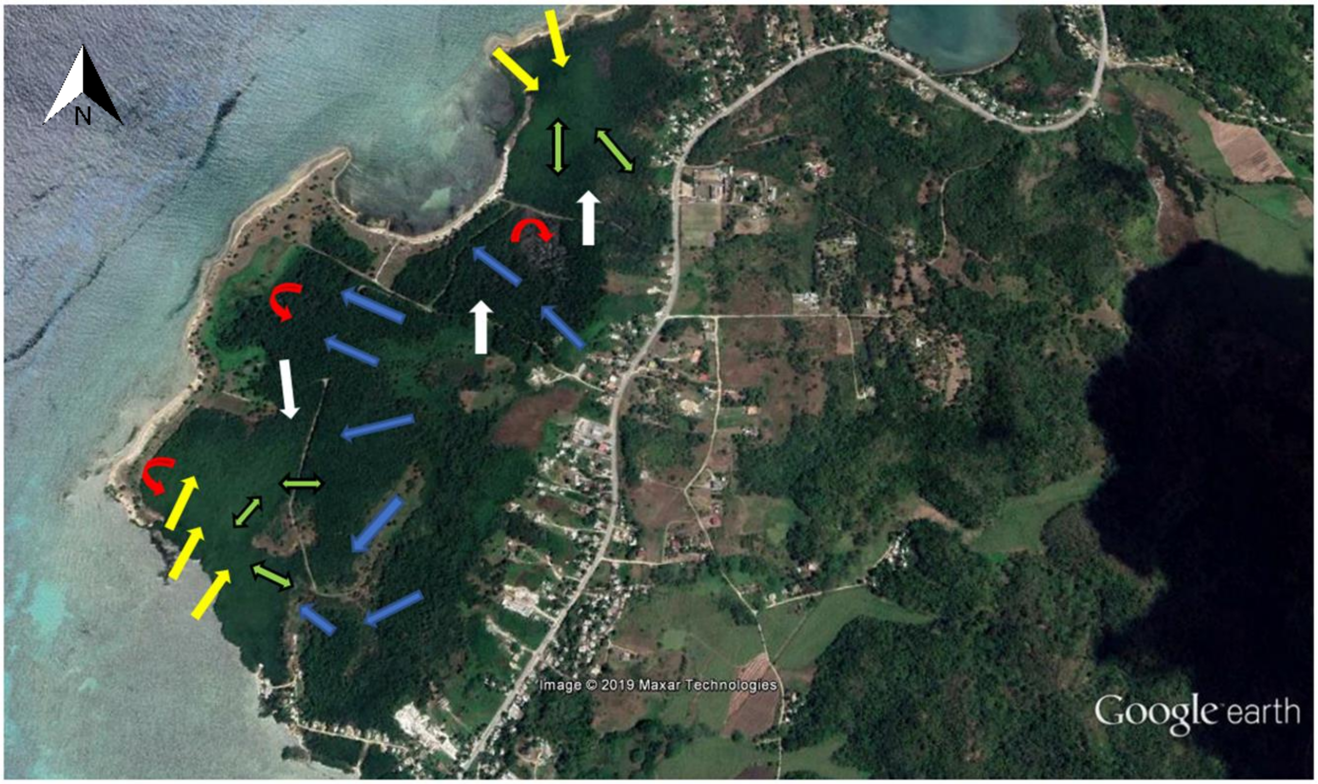


Figure 6-12 Observed wetland surface hydrology regime

6.1.6.3 Water Levels

A strong tidal movement was observed at the eastern "service road" canal (**Error! Reference source not found.**) area during site visits and confirmed with Hobo U-20 water level logger data collected from that location. Table 6-2 below provides water level logger results.

Table 6-2 Water level logger results: PSI converted to centimetres (cm depth)

	Drainage 1	*Drainage 2*	*Drainage 3*
Max (PSI)	14.92	14.72	14.72
Mean (PSI)	14.67	14.64	14.63
Difference	0.25	0.08	0.1
cm depth	**17.65**	**5.62**	**7.03**

The northern edge of the proposed drainage pond received a mean water level of 17.65cm of water during a 2-week monitoring period (Figure 6-13). The degraded mangrove west of the service road is an end point for fresh water travelling north (from Culvert 5). A water level logger on the edge of the area showed an average recorded water depth of 5.86 cm over a 2-week period. More importantly the area showed a clear peak in water level on 4 October 2019 likely linked to a rainwater event (Figure 6-14). The daily water level fluctuation was not very drastic, indicating a weak or negligible tidal influence. A salinity of 0ppt recorded during all four field visits confirms that this area is a freshwater end point with no significant tidal exchange.

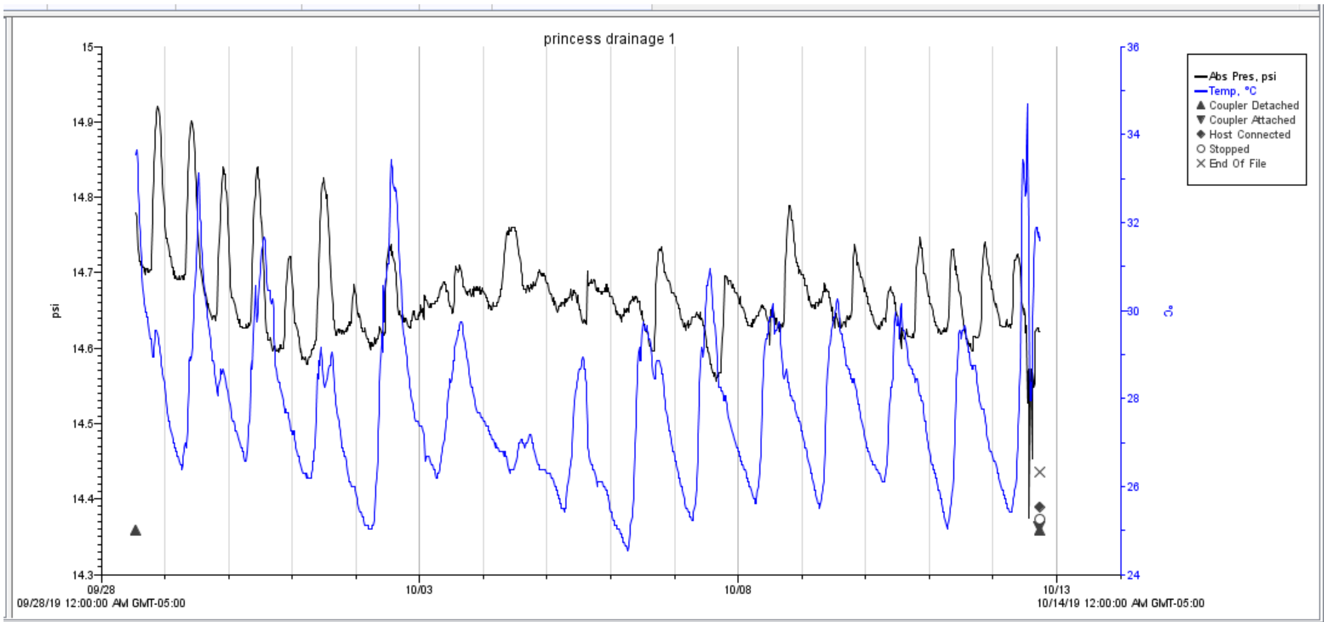


Figure 6-13 Water level logger results for western drainage pond area periphery

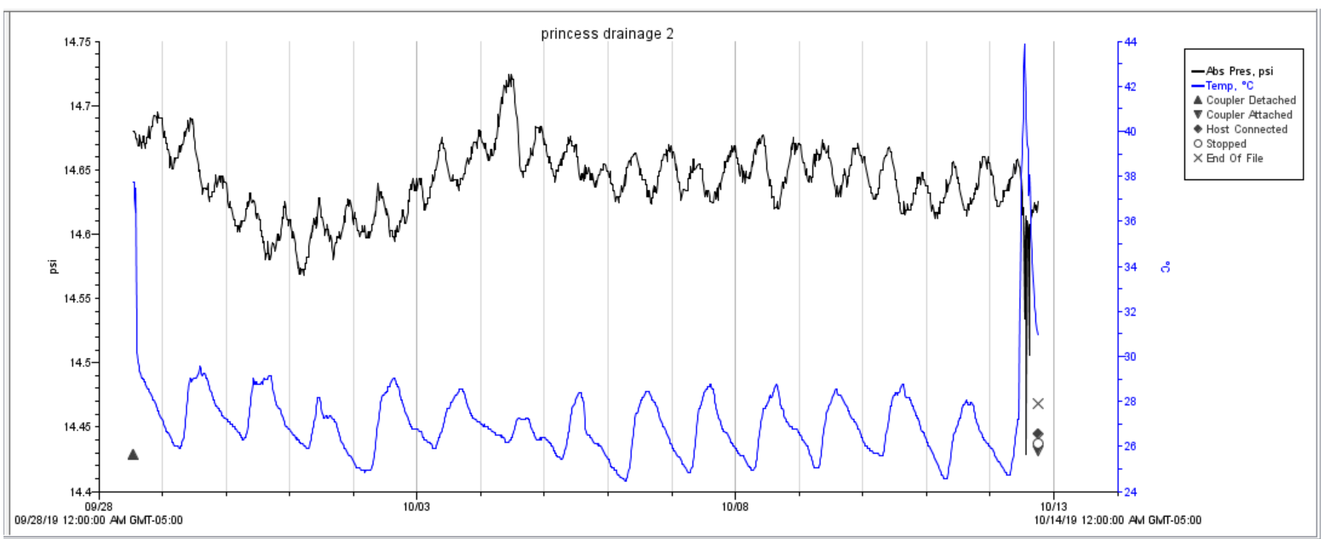


Figure 6-14 Water level logger results for degraded mangrove section along service road

Figure 6-15 shows that the area receives regular tidal fluctuations. The mean tidal height of this area was calculated at 6.87cm. This low tidal height is expected as this location is over 300m away from the coastline. All loggers reflected a matching peak in water level on 4 October 2019 despite being physically separated, hundreds of meters apart. This gives evidence that the mangrove forest receives pulses of fresh water during rainfall events.

Most roadways have no culverts to allow forest connectivity and drainage. An ideal example of the lack of forest connectivity may be found at the western-most access road. This road, which is of marl and rubble construction, showed a segregation of fresh and tidal salty waters, separated by a 2m wide road. However, previous records of salinity show that the areas have some amounts of water exchange through or below the roadway.

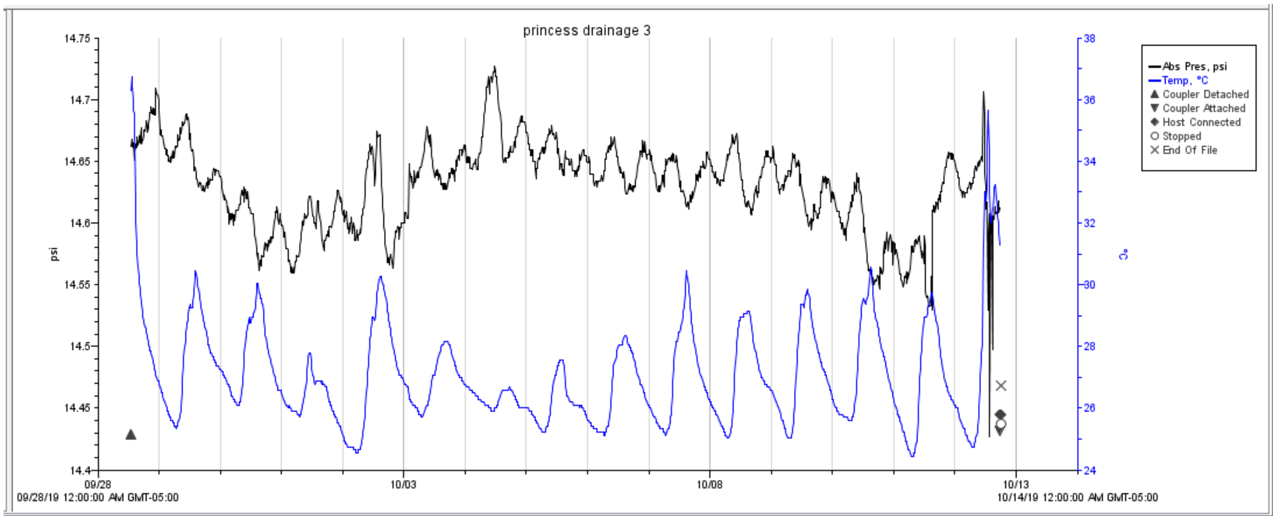


Figure 6-15 Water level logger results for eastern degraded mangrove section, east of the service road

A very clear northern movement of fresh water beneath the roadway was observed on the field visit on 12 October 2019. This section of roadway had a wooden log perpendicular beneath the roadway (Plate 6-2), which is seemingly rotting and provided a passage for the fresh water to enter the tidal mangrove section. A salinity of 0 ppt was measured here on both sides of the roadway.

Plate 6-2 Western access road with log beneath roadway provides visible route for freshwater movement below the road

6.1.7 Bathymetry

This section describes the offshore (deep water) bathymetry and the nearshore bathymetry (from boat surveys) and beach profiles.

6.1.7.1 Method

Bathymetry data were collected from two sources for this project. These sources are discussed below. All nearshore data was combined and is presented in Figure 6-16.

Bathymetry and Beach Profiles

The bathymetric survey was done using an echo-sounder and GPS device aboard a small boat. The Odom EchoTrac sounding device was mounted in an over-the-side configuration and was used to provide the water depth information. While the echo sounder recorded water depths, the Trimble RTK GPS simultaneously recorded spatial coordinates for each reading. As the boat traversed the nearshore area to create bathymetric tracks the measurements were automatically stored to a field computer. The measurements were converted to the national coordinate system and depths were referenced to mean sea level (MSL). The reduced depths and positions were then used to aid in the generation of contours for the nearshore of the project site. Using a theodolite, a total of 41 beach profiles were done along the shoreline of the property. The survey measures the depths to which a person could comfortably walk out to sea.

Satellite-derived Bathymetry

Data obtained from DHI was at a 90m x 90m spacing. This data set extended over 8km seaward of the site. More refined data was also collected from EOMAP that had bathymetric data in a 1x1m spacing. The collected bathymetric data was used to validate the EOMAP satellite data.

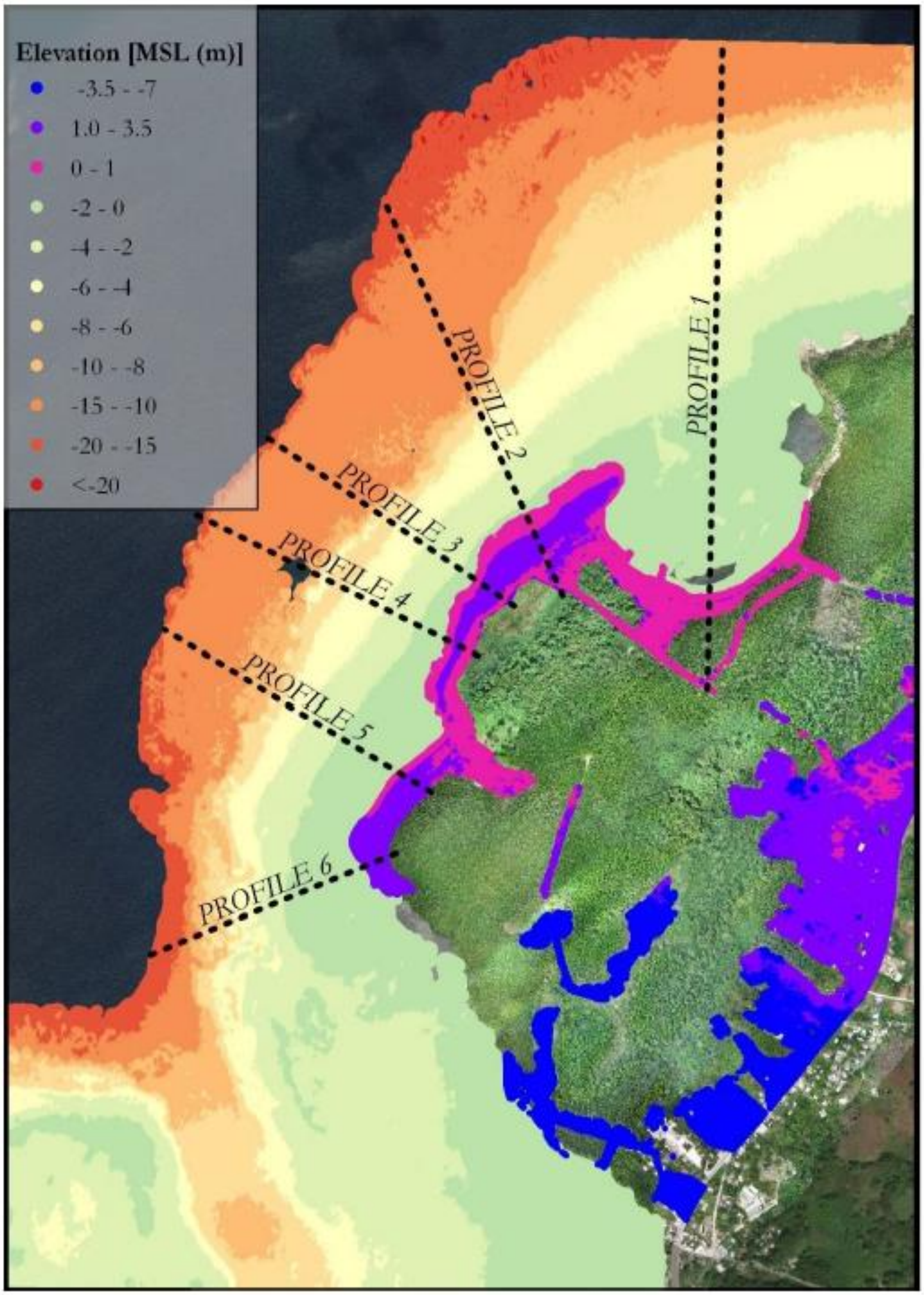


Figure 6-16 Collation of nearshore and terrestrial elevation points referenced to mean sea level

6.1.7.2 Results

Hotel 1

There is a reef system offshore of Hotel 1 (20-30m wide). Some sections of the reef are only submerged by approximately 0.5m of water. At Hotel 1, the backshore does not go above 1.5m MSL. A typical 1 in 50-year hurricane usually has a static surge greater than 1m. It can therefore be assumed this site can easily become inundated under hurricane conditions.

Hotels 2 and 3

Along this section of the bay the backshore is above 2.5m. This section of the shore could be protected from storm-related flooding, but the low landward section could still face flooding.

Hotel 4

Along Hotel 4, the nearshore is only about 0.5m deep. Further out, water depths increase significantly. Like Hotel 1, this section of the site would also be submerged under the 1 in 50-year hurricane condition.

Figure 6-17 shows profile survey results along various sections of the site shoreline.

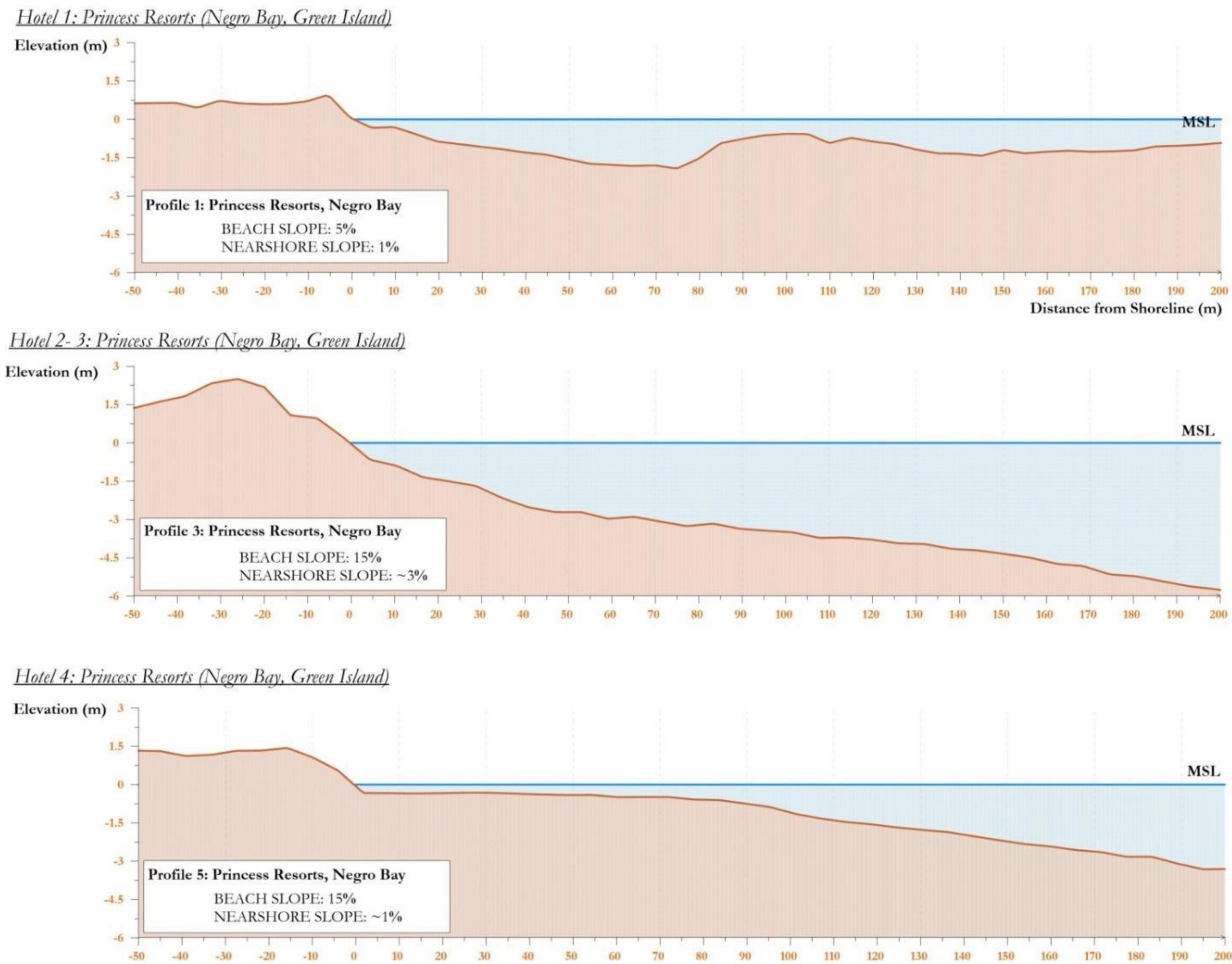


Figure 6-17 Typical sections along shorelines of property according to hotel blocks

6.1.8 Currents and Tides

6.1.8.1 Methodology

Four (4) drogue tracks were done for the area. This involves placing a submerged floating device in the sea and tracking it with an onboard GPS. This is a measurement of the surface currents in the area. The drogues were deployed at four different locations within the cove (Figure 6-18).

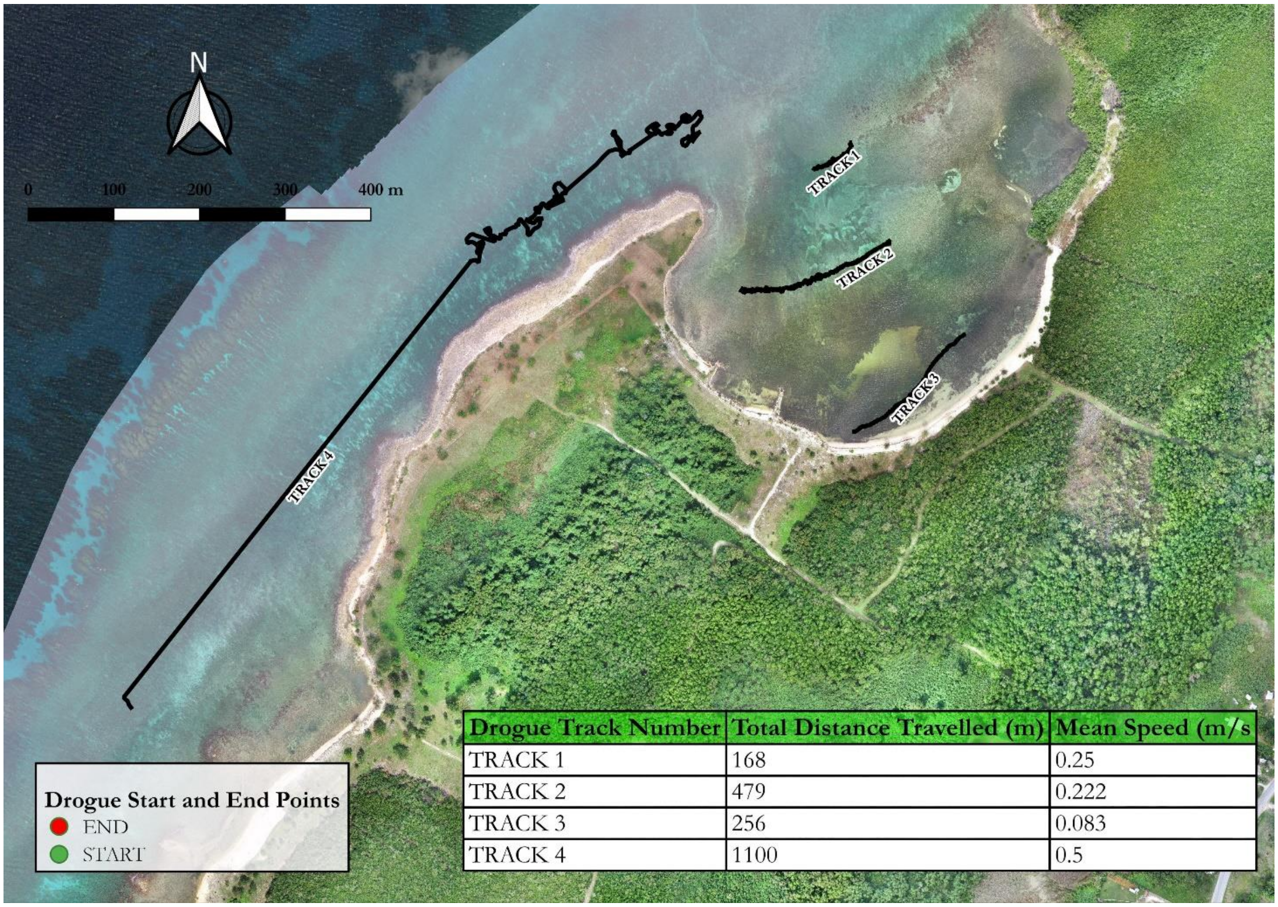


Figure 6-18 Drogue tracking – Current measurements

6.1.8.2 Results

All drogues moved toward the west as expected. All the drogues deployed inside the cove ran into the shoreline and stopped. This indicates that there is a tendency for any floating material to be brought into this area. This also implies that the current moves slowly and has contributed to the deposition of debris such as black/brown dead seagrass. The currents in these areas will have to be improved via a proposed channel. **Track 4**, which is outside of the bay, showed current speeds more than 50% higher than currents in the bay. The creation of a channel connecting the cove to this current could help with reducing stagnation in the bay.

In general, currents at the site flow in a westerly direction. The currents are strongest in areas where waves break, i.e. along the rocky shore of Hotels 2 and 3 and the shallow area of Hotel 4. The breaking of waves on the reef at the opening of the cove also causes these strong currents to pull water out of the cove and cause significant movement of any sediment in the area. Therefore, the shoreline of Hotels 2 and 3 is rocky; there is no opportunity for sand to stay in place. A perched beach in this area (as currently proposed) will create valuable sunbathing areas that would not be eroded by the strong currents. The cove beach in front of Hotel 1 has slow-moving currents that will cause stagnation in the area. Runoff into the bay must therefore be limited to preserve good swimming conditions. Figure 6-19 shows 20-year mean current speeds and directions at the project site.

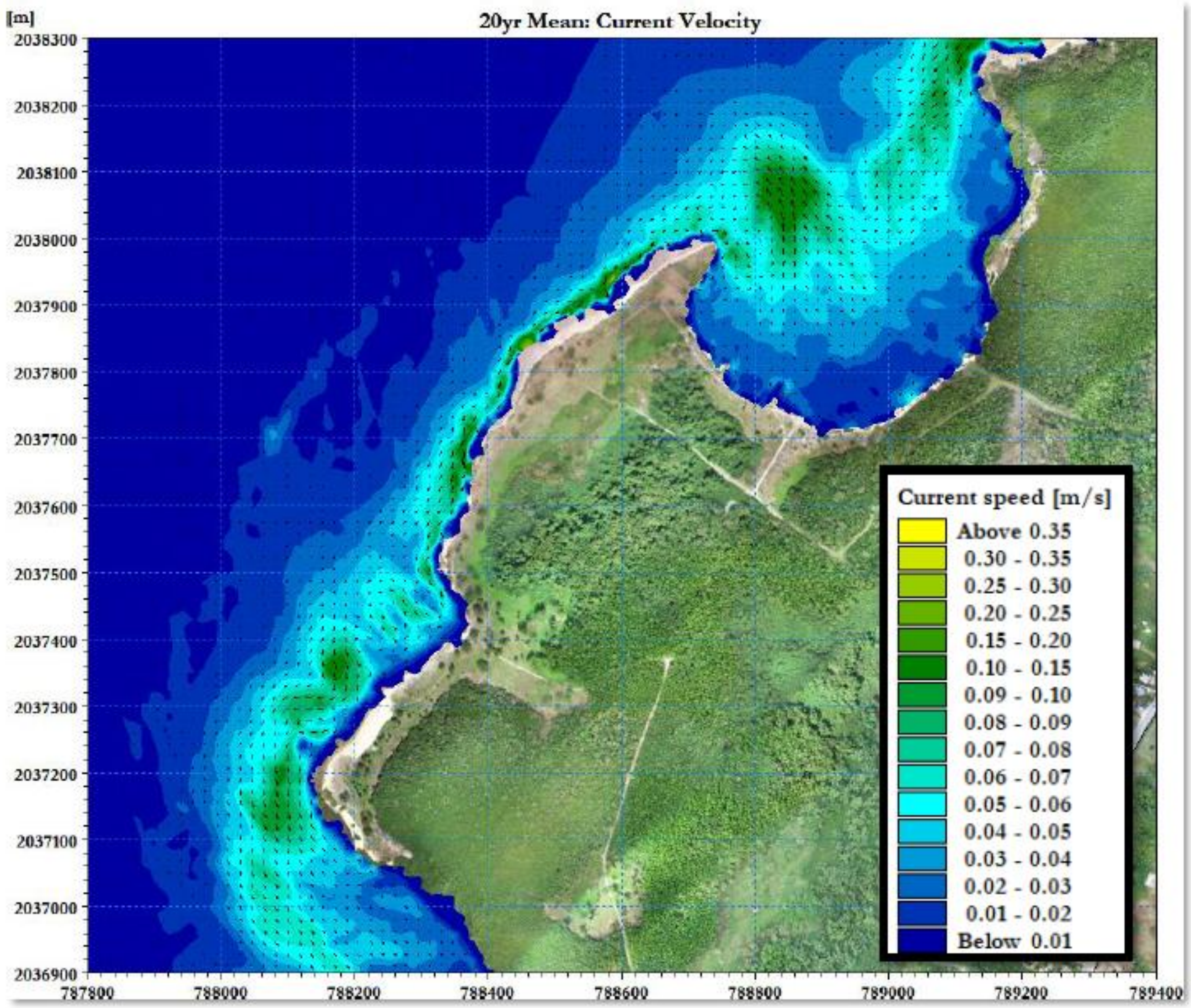


Figure 6-19 Current speeds and directions at project site

6.1.9 Wave Climate

Coastal hazards that affect the coast include flooding from storm surge due to hurricanes and chronic shoreline erosion from daily waves and swell waves. To understand the daily wave climate and storm surge potential of the area, detailed numerical modelling was carried out and the results are presented in this section. Potential erosion at the site due to swells and hurricanes is also presented.

6.1.9.1 Numerical Model Domain

MIKE21, a coupled wave-hydrodynamic-sediment model developed by the Danish Hydraulic Institute, was set up for this project area. The model was used to transform wind and wave fields from deep water to the nearshore at the project site and to determine both operational wave conditions and hurricane wave conditions, including storm surge and inundation. Figure 6-20 shows the MIKE21 flexible mesh representing the seabed that used for the modelling.

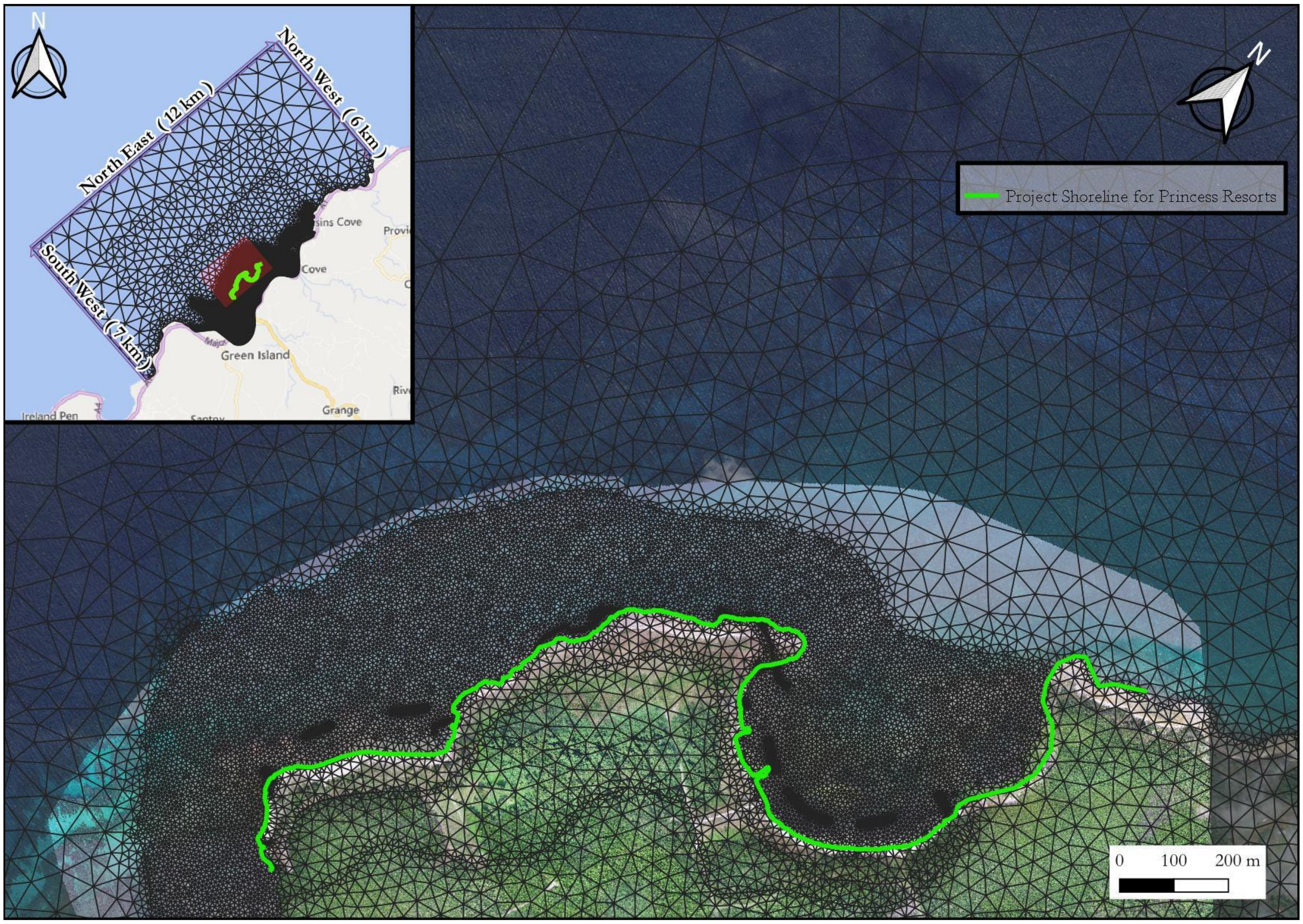


Figure 6-20 Numerical model domain

6.1.9.2 Model Validation

Before beginning the numerical modelling, the first step is to validate its performance by comparing it to actual measurements in the field. The model was tested to see if it reflected the results obtained from the drogue tracking. We used the MIKE21 Transport module combined with the Wave (SW) and Hydrodynamic (HD) modules. This set-up shows what would happen to a dispersive pollutant introduced into the sea. The floats were treated as pollutants and introduced to the model at the same time it was deployed during the actual field investigation. The black line shows what happened in the field and the red is what the model predicted, which is a very close match (Figure 6-21).

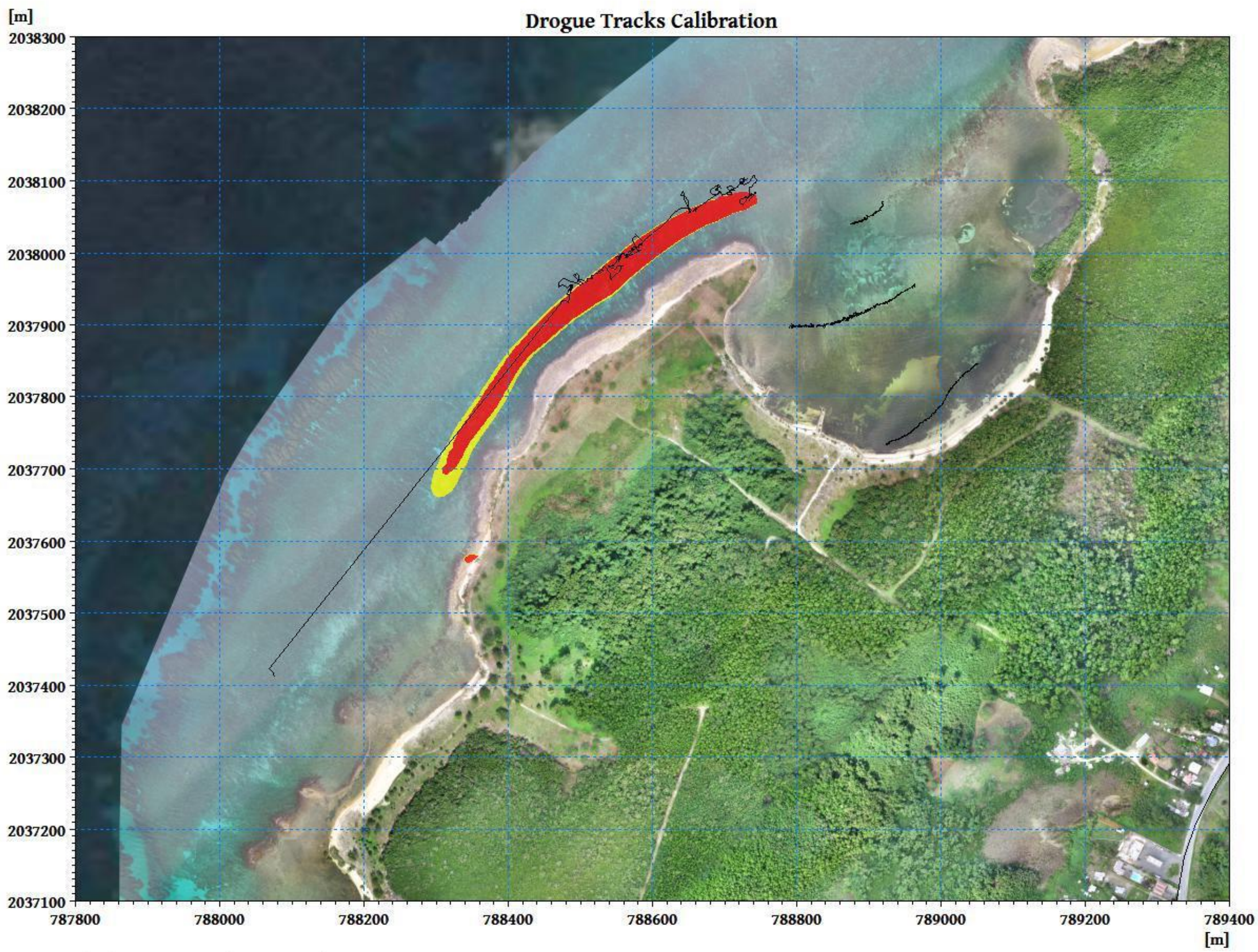


Figure 6-21 Pollutant track (red) overlain on drogue track (black)

The model shows the introduced pollutant moving in the same direction as the drogue (Figure 6-22). The speed of the drogues was also close to the modelled currents. Track 4 had a mean speed of ~0.5m/s while the model predicted a mean current speed of approximately 0.43m/s. This validation implies that the model can reliably predict current speeds and directions for the area and is therefore suitable for the investigations to be conducted.

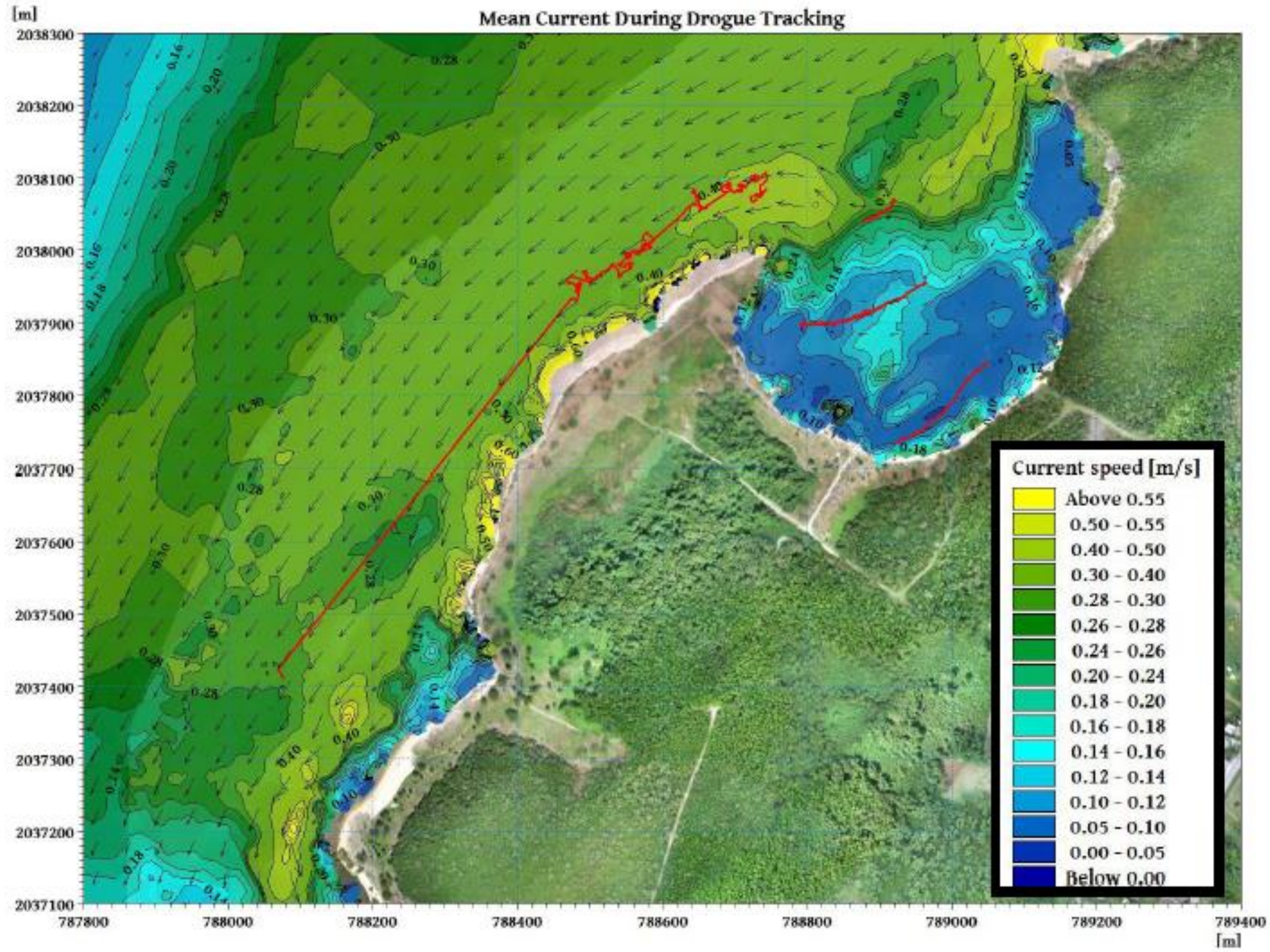


Figure 6-22 Mean current speed during the drogue measurement period

6.1.9.3 Offshore Wave Climate

The operational wave climate at the project site is characterized by (a) day-to-day, relatively calm conditions and (b) seasonal winter swells (December to May). The day-to-day conditions are created by the north-east Trade Winds. The north coast of Jamaica is especially vulnerable to these wave conditions because of its location. The swells, on the other hand, are generated by north Atlantic cold fronts and these waves can approach from the north to north-west sector.

The deep-water operational wave climate describing the day-to-day wave conditions was obtained from the global wave model Wave Watch 3 (WW3) developed by the US National Oceanic and Atmospheric Administration (NOAA). The WW3 model archives wave parameters including wave height, period and direction as well as the wind speed and direction. Data is available for every three hours from July 1999 to April 2015, giving a total of over 46,000 data points per parameter and covering almost 16 years. This time series of wave conditions was extracted for a node located north of Jamaica. Figure 6-23 shows the wave height distribution and the location of the node (Node 8) that was selected for the project. Note that most of the waves come from the east sector, as dictated by the Trade Wind patterns.

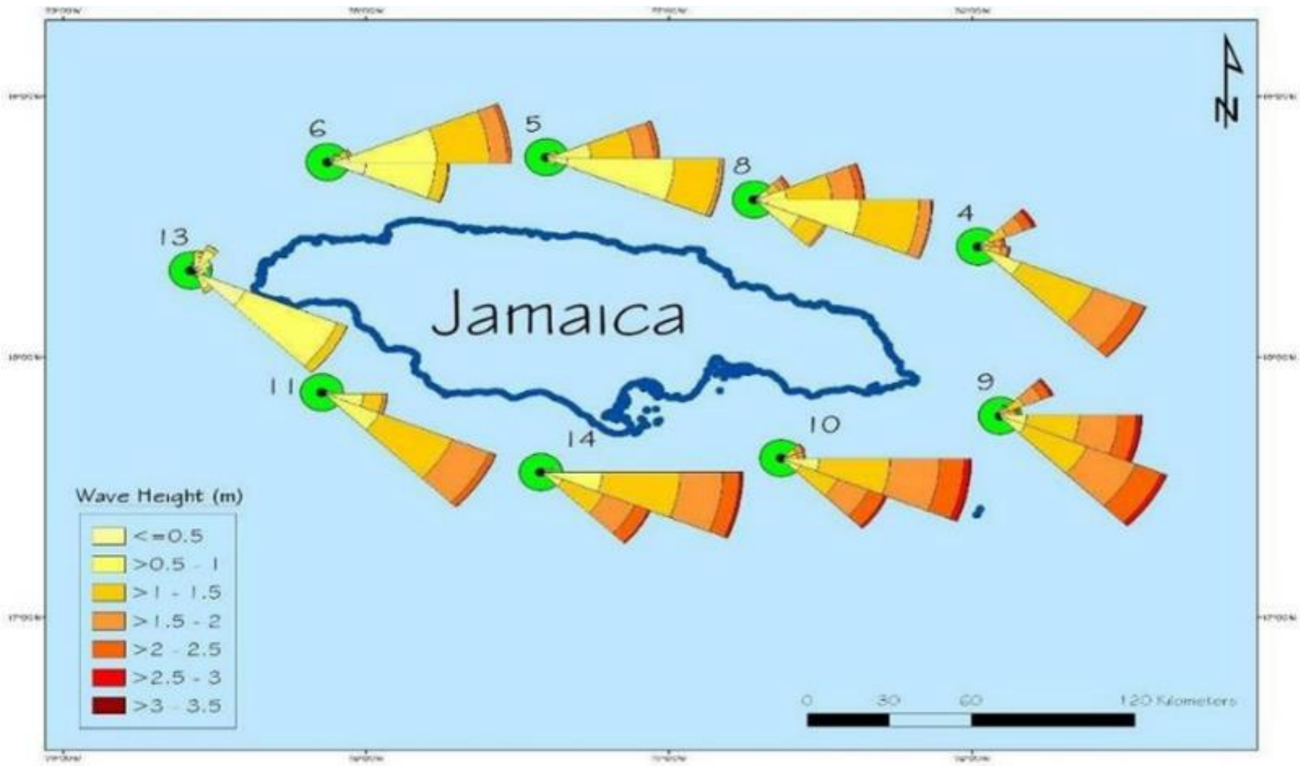


Figure 6-23 NOAA Wave Watch 3 nodes

6.1.9.4 Nearshore Wave Climate

The WW3 model used by the NOAA is usually applied on spatial scales (grid increments) larger than 1-10km and outside the surf zone. As a result, the model is not at a sufficiently detailed scale to provide accurate nearshore wave data. The nearshore wave climate for this project was therefore developed using a spectral wave model MIKE21 SW to simulate waves as they approach the nearshore of the project site. The basic starting point of the model is the creation of a computational mesh where waves and currents are determined at each simulation time step. The MIKE21 model uses a flexible mesh that represents the seabed using a series of connected triangular and/or quadrangular elements. The bathymetric data is then interpolated on the flexible mesh to create the model domain. As shown in Figure 6-20, the model domain extends out to water depths of at least 1000m and captures the changing contours, which tend to run parallel to the shoreline.

The validated model was used to investigate mean wave conditions within the bay. Twenty (20) years of wave data was used to predict the conditions at the site and found that over the past 20 years the average wave heights within the bay were less than 0.3m. These wave heights are good for comfortable wading/swimming and other recreational activities in the bay. In contrast, along the shoreline of the proposed Hotels 2 and 3, the average waves were shown with values over 0.7m. This will be unsuitable for recreational activities year-round. This confirms that the proposed revetment for this area will have to be elevated in this section to prevent uncomfortable sea spray from the crashing daily waves.
This also justifies the need for the proposed structures to create the new beach between Hotels 3 and

4.

Nearshore reefs along the shoreline of Hotel 4 create a sheltered area with waves less than 0.2m in height. The sudden breaking of the waves, however, results in a strong current flow that has been causing erosion of the shoreline. Figure 6-24 shows the 20-year mean wave heights and directions for the site.

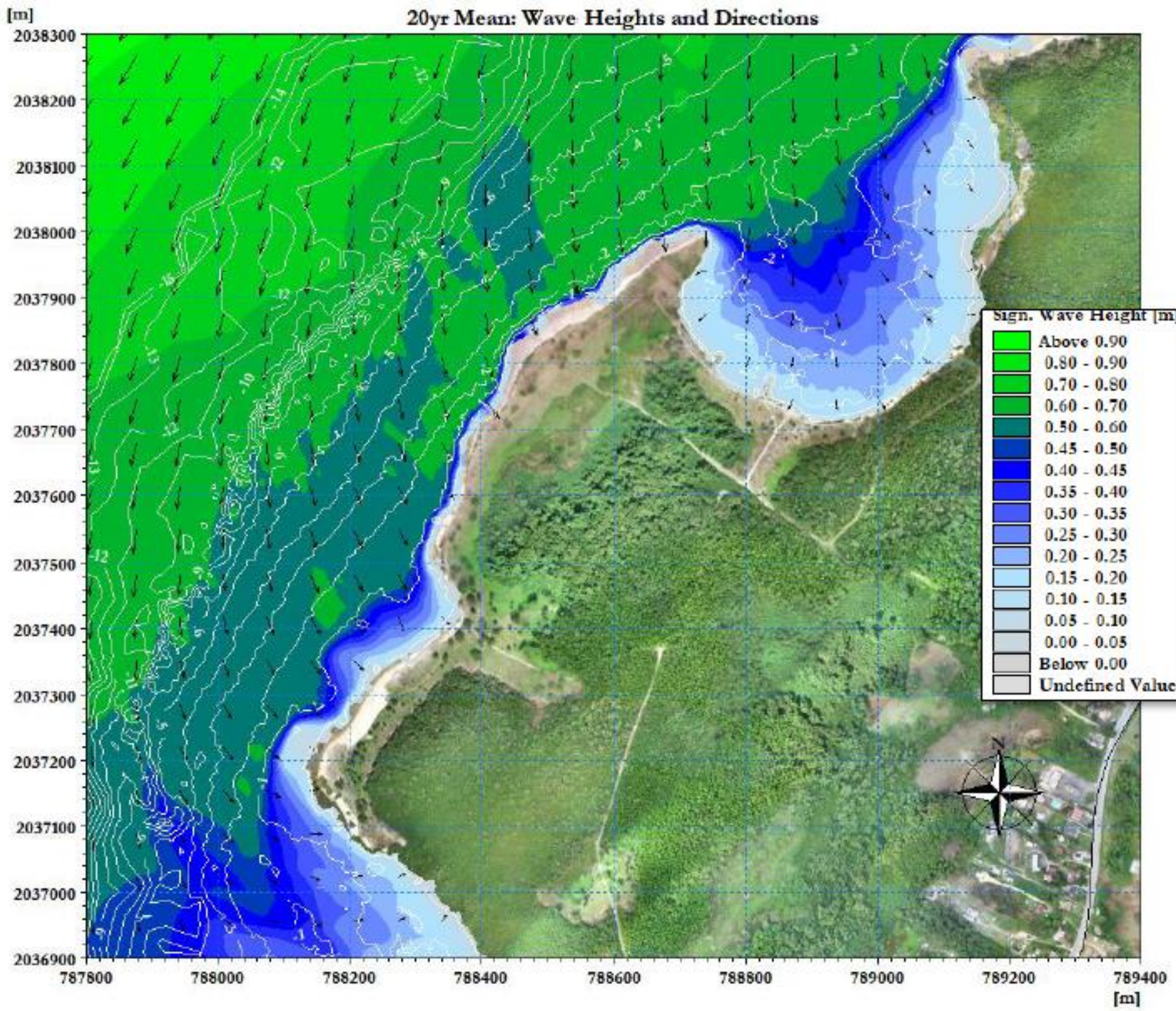


Figure 6-24 20-year mean wave height and wave direction

6.1.10 Shoreline Morphology and Stability

Shorelines may show signs of dynamism, as they build up during the summer months when the conditions are calmer and erode during the winter months when the wave conditions are stronger due to ocean swells. This section of the report presents shoreline trends along the project site. Historical movement of the shoreline and results of the numerical modelling were used to predict trends for the area.

6.1.10.1 Historical Shoreline Analysis

The assessment of erosion and accretion trends in an area starts with an inspection of aerial images of the site over time. A total of eight images were obtained spanning a 16-year period (2003 to 2017) (Figure 6-25). The images were georeferenced, and the shorelines were digitized.

From the initial inspection it was found that significant erosion occurred within the bay of Hotel 1 and the beach at Hotel 4. The rocky shoreline (ironshore) at Hotels 2 and 3 did not change over the 16 years and suggests that it stable. Figure 6-26 shows that at Hotel 1 and Hotel 4 the beach width decreased by 35m and 28m respectively. Six reference points at the back of the shoreline were used to measure the distance to shoreline. This provides an idea of the amount of fluctuation in beach width over the years. The shoreline had the most fluctuation between 2003 and 2009 (Figure 6-27). Between 2014 and 2019 the rate of erosion within the bay of Hotel 1 slowed, suggesting a tendency to equilibrium or stability. For the beach at Hotel 4, there is some level of dynamism (erosion and accretion), but the overall trend is one of erosion.

Based on aerial images in 2003 and 2004 the shoreline was predominantly mangrove coast. Mangrove coasts are more resistant to coastal erosion. Sometime before 2009, the mangroves at Hotels 1 and 4 were removed. Since then, coastal erosion in the area increased. This explains the notable reduction in beach width as seen between 2004 and 2013.

Figure 6-25 Satellite Imagery of proposed project site from 2003 - 2017

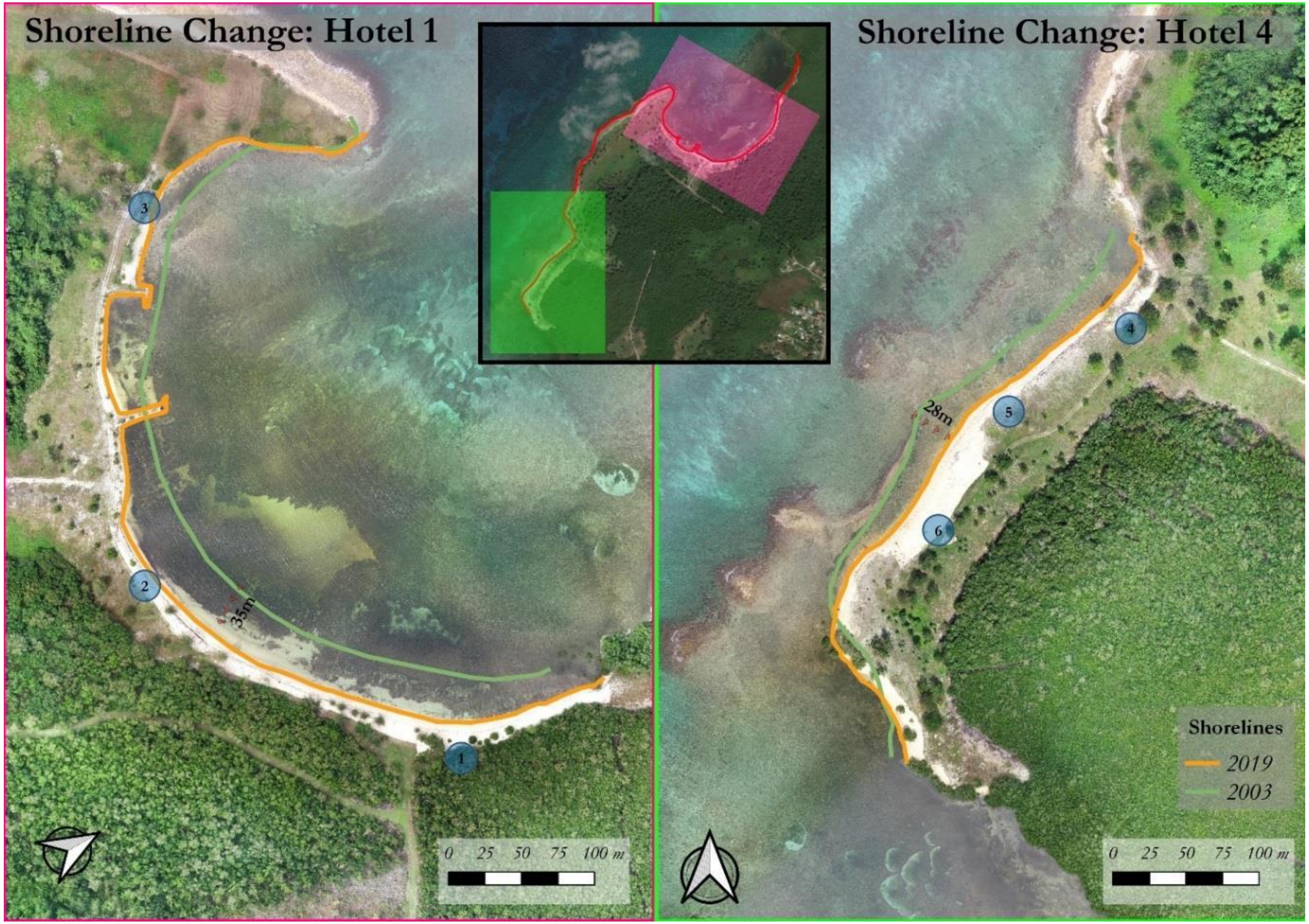


Figure 6-26 Satellite Imagery of sandy beach sections showing most seaward and landward shorelines

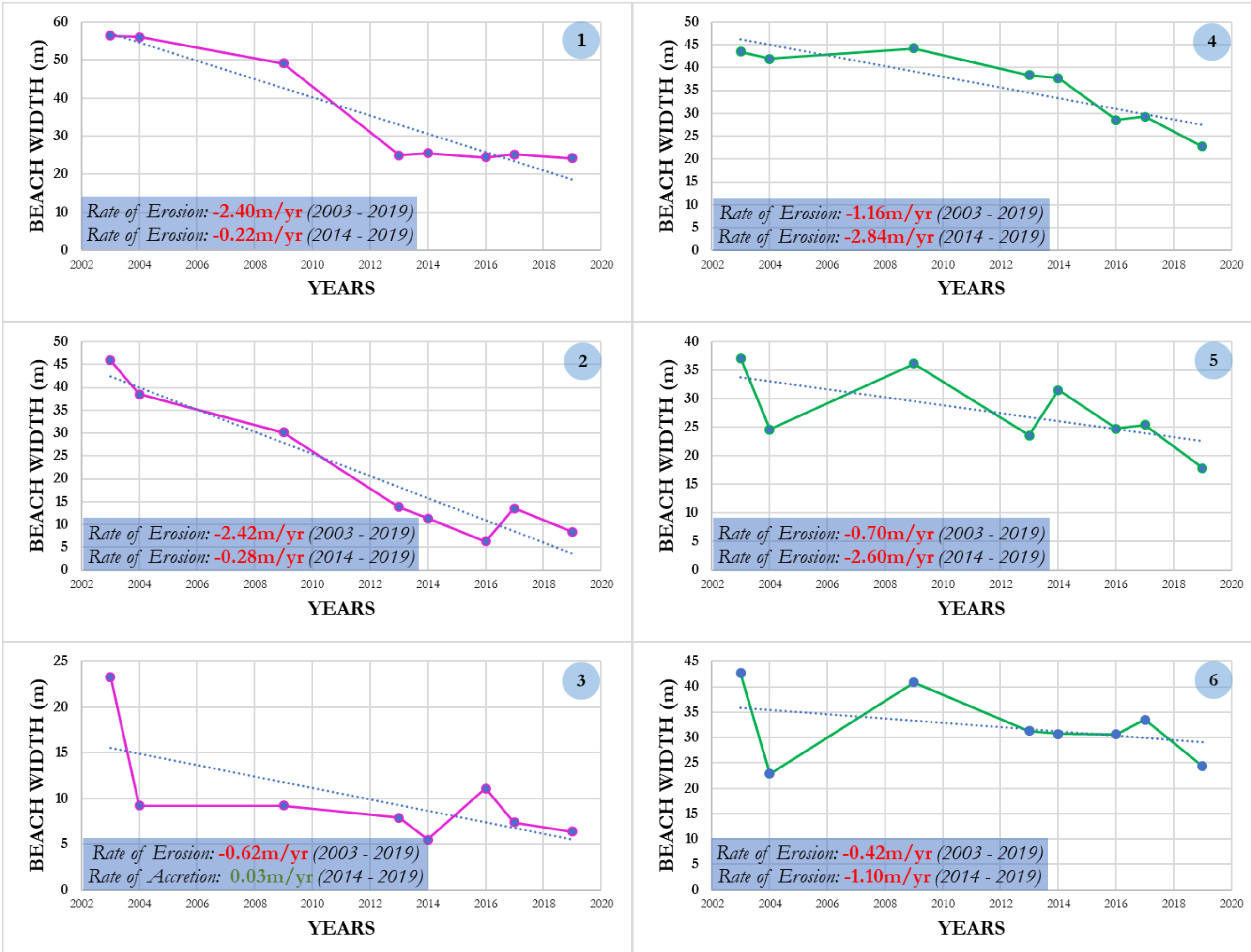


Figure 6-27 Fluctuation in beach widths throughout the project property

6.1.10.2 Alongshore Sediment Transport

Using the mean annual wave climate, potential alongshore sediment transport was estimated for three profiles. The resulting distribution of cross-shore sediment transport in the nearshore is given in Figure 6-28, Figure 6-29 and Figure 6-30.

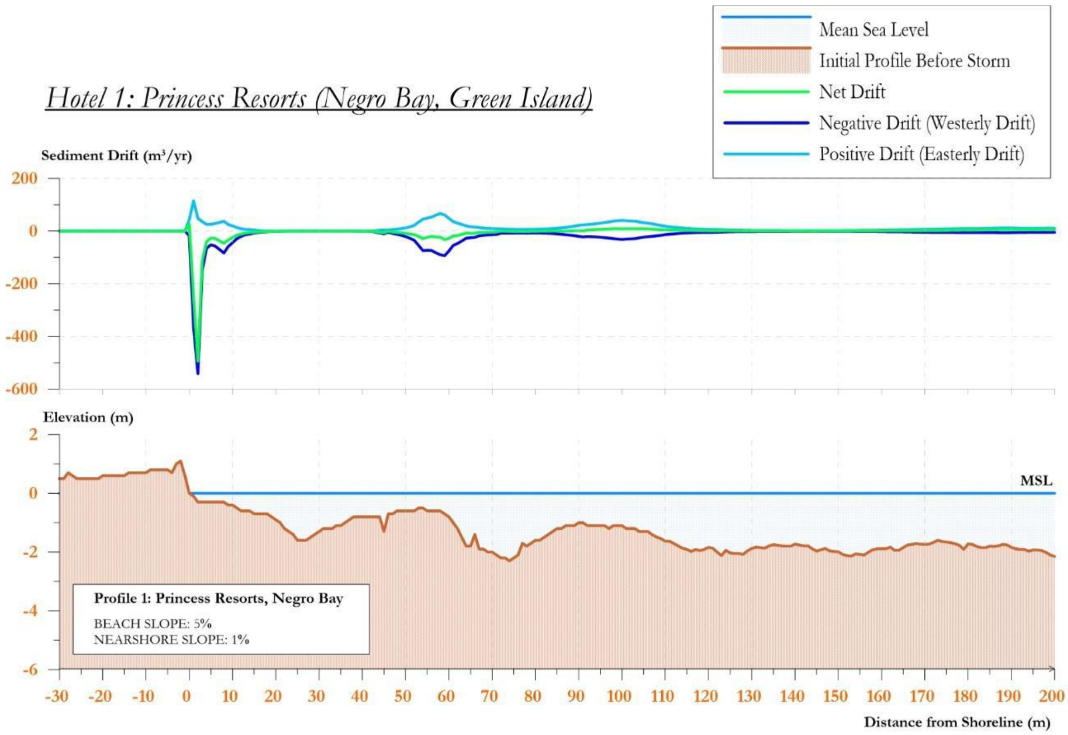


Figure 6-28 Alongshore sediment transport along cross-shore of Hotel 1

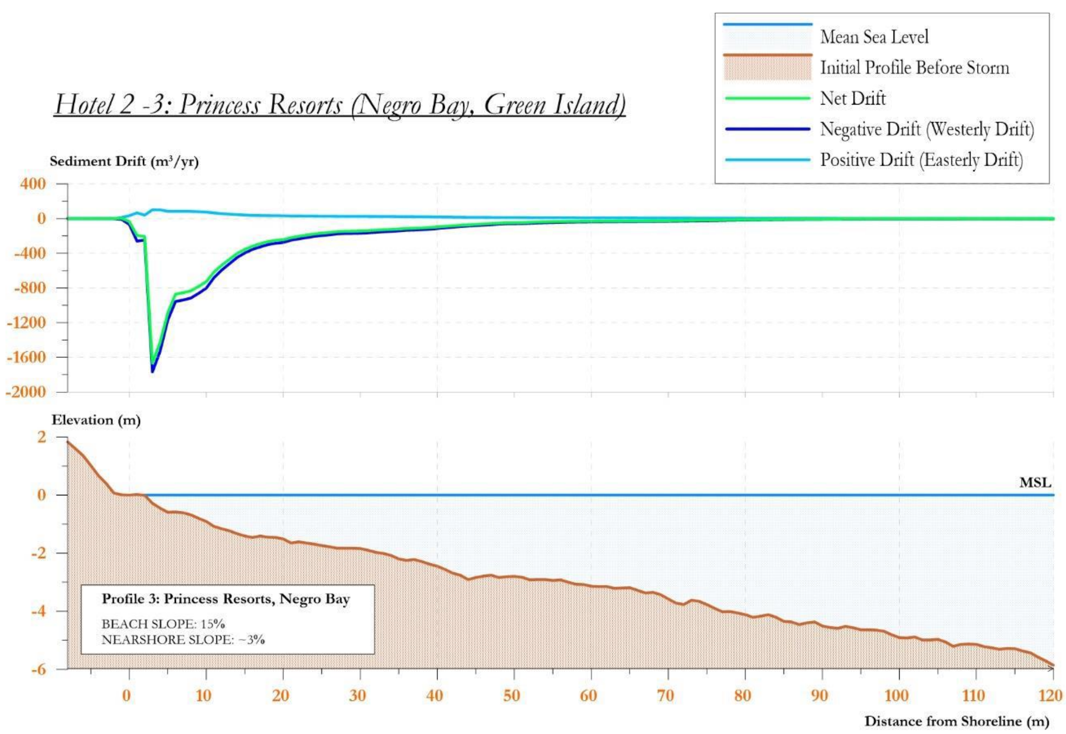


Figure 6-29 Alongshore sediment transport along cross-shore of Hotels 2 and 3

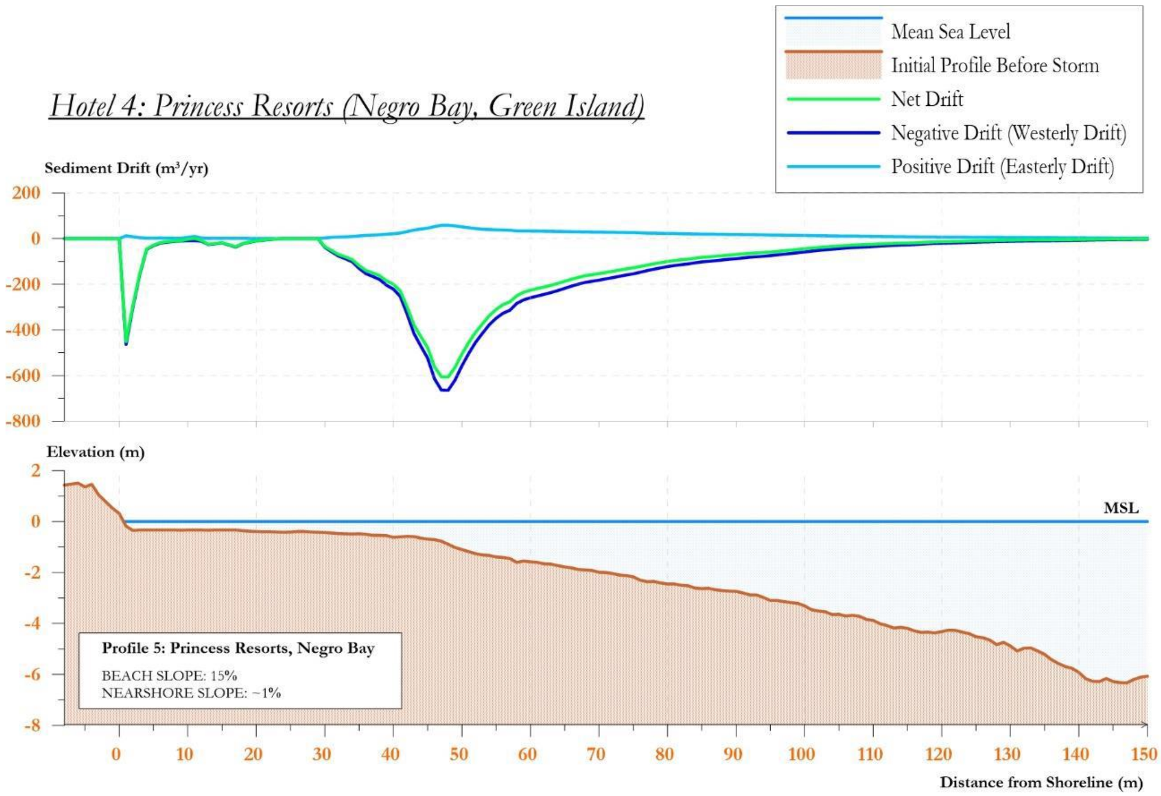


Figure 6-30 Alongshore sediment transport along cross-shore of Hotel 4

Key points to note are:

- The main direction of sediment drift is toward the west.
- The bulk of sediment transport at Hotel 1 occurs within the first 20m offshore while for Hotels 2 and 3 the bulk of transport occurs approximately 70m offshore.
- The impact of the reef system is clearly shown at Hotels 1 and 4. The wave-breaking process at Hotel 4 occurs at the reef and there is a notable increase in the amount of sediment transport on the reef.
- The amount of potential sediment movement along the rocky shore (Hotels 2 and 3) is almost three times that of Hotels 1 and 4. This indicates a limitation for placing sand along the shoreline in this area. Any sand placed here would have to be protected from the high potential for sediment movement.
- The LITDRIFT model is somewhat limited because of its dependence on alongshore transport, whereas the shape of the beaches in this area means they are swash-aligned. Swash-aligned beaches have a predominant cross-shore drift (i.e. sand moves toward and away from the shoreline). The model is not able to account of this. This is evident as the westerly drift predicted is not supported by the aerial images of the site. If the sediment movement was mainly westerly, a build-up of sediment at the groyne would be seen. For these reasons, MIKE21 ST model was used to incorporate the coupling of alongshore and cross-shore sediment movements.

6.1.10.3 Beach Response to a Swell Event

A swell event represents a period during the operational wave climate when the amount of wave energy reaching the shoreline is significantly increased. This wave energy can cause notable overtopping and wave-driven erosion. This section of the report describes the morphological response of the shoreline under such extreme operational wave conditions.

To assess the effects of the swell wave conditions at the site, it was necessary to evaluate the 18 years of offshore wave data. This was done by filtering the swell events from the wave dataset. A total of 76 swell events lasting more than two days were found in the wave database. The swell selected from the filtering was the one that had the highest wave heights and came from the NW and occurred from 1-10 March 2009. At the peak of this swell, wave heights were greater than 3m and had wave periods longer than 8s.

The results (Figure 6-31) indicate that most of the sediment movement occurs along the rocky shore. The shallow depths within the bay of Hotel 1 do not support the amount of mixing needed to increase the movement of sediments in the area. Similarly, the reef system at Hotel 4 does not support a lot of sediment movement.

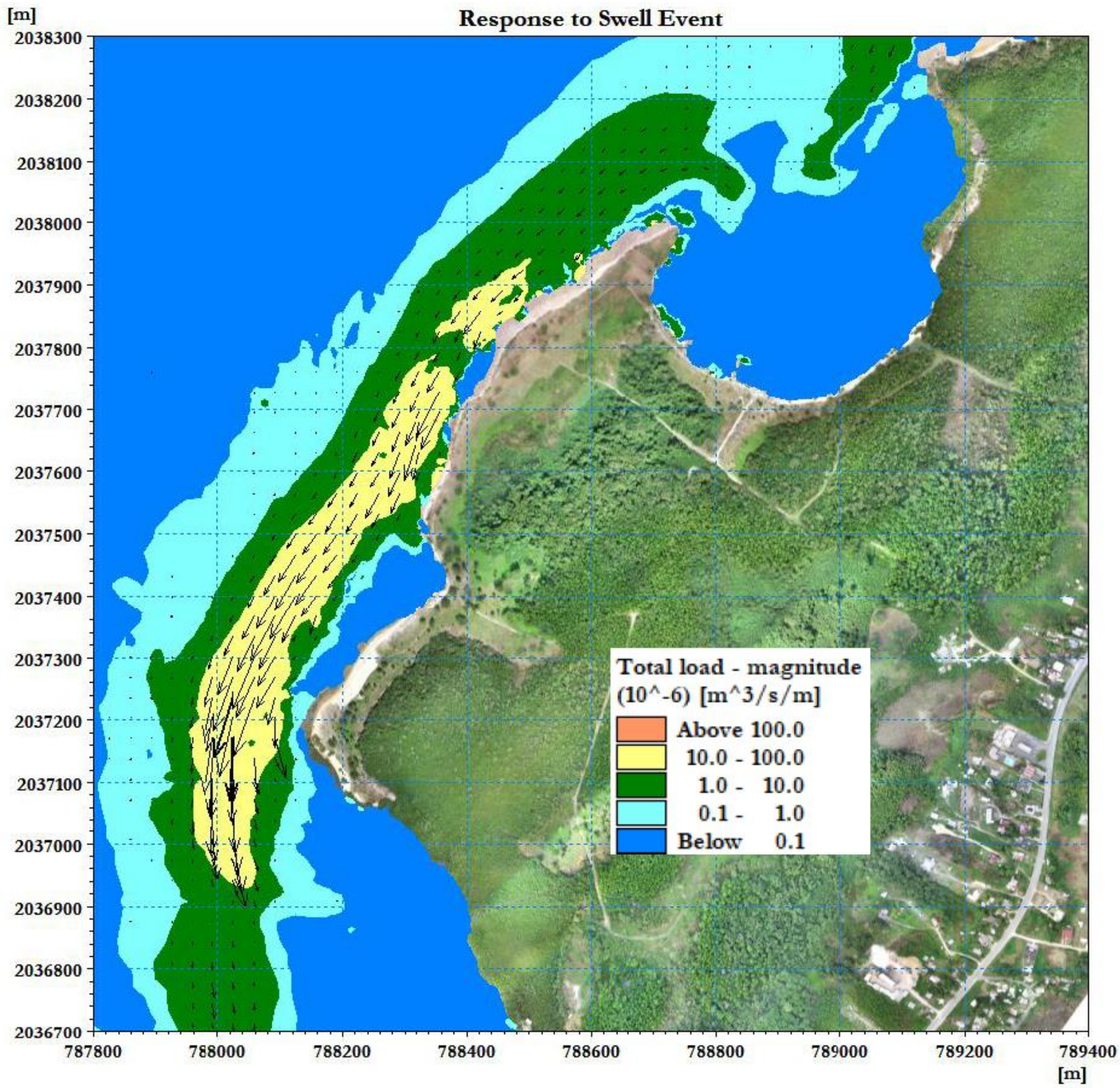


Figure 6-31 Total number of suspended sediments and the direction of flow at the peak of the swell event

6.1.11 Water Quality

6.1.11.1 Methodology

Water quality sampling exercises were conducted at twelve (12) stations on August 20th, September 19th and November 4th, 2019. Weather conditions were fair and sunny on the August 20th and November 4th sampling runs; however, conditions were overcast with intermittent rainfall on the September 19th sampling run. The sampling locations are listed in Table 6-3 and illustrated in Figure 6-32.

Table 6-3 Water quality sampling locations (JAD2001)

STATIONS	NORTHINGS	EASTINGS
1	696472.908	616508.733
2	696250.278	616466.110
3	696060.047	616491.967
4	696027.256	616618.411
5	695891.167	616324.129
6	696021.116	616128.967
7	696165.748	615519.357
8	695884.495	615803.255
9	695479.547	615633.163
10	695238.767	615551.058
11	695004.886	615737.638
12	695043.618	615975.780

Figure 6-32 Water quality sampling stations

Temperature, conductivity, salinity, dissolved oxygen, turbidity, Photosynthetically Active Radiation (PAR) – light irradiance, total dissolved solids and pH were collected using a Hydrolab DataSonde-5 water quality multi probe meter (Calibration Test Sheet in Appendix 4). Light extinction through the water column was calculated from PAR values recorded, however, due to extremely shallow depths (<0.5 m) at Stations 2, 3, 4, 6, 9, 10, 11 and 12, light extinction could not be calculated at these stations. Whole water samples were collected in pre-sterilized bottles, stored on ice and taken to Caribbean Environmental Testing and Monitoring Services Limited (CETMS Ltd.) for analysis of Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), nitrate, phosphate, faecal coliform and *Enterococcus*. Samples were also shipped to Test America Laboratories in Florida for analyses for Total Petroleum Hydrocarbons – Gasoline Range Organics (GRO C6-C10), Diesel Range Organics (DRO C10-C28) and Oil Range Organics (ORO C28-C35).

6.1.11.2 Results

Table 6-4 depicts the average physical data results and Table 6-5 shows the average biochemical data results. **Stations 1, 2, 3, 5, 6, 7, 8, 9, 10 and 11.**are regarded as **marine water** due to their locations and were compared with NRCA Marine Water Quality Standards. The remainder of the sampling stations (**Stations 4 and 12**) located within the mangrove swamp, are regarded as **brackish water** or **freshwater** and were compared with NRCA Ambient Freshwater Standards.

Average temperature values were all considered normal for brackish/freshwater and marine water. Marine water temperatures recorded were expected in a tropical marine area influenced by the Trade Winds (≈27 –30 ^{o}C). Temperature values at the two brackish/freshwater stations were noticeably lower than that of the marine stations. Conductivity, salinity and TDS values were all considered normal for both brackish/freshwater and marine water. The average conductivity values at Stations 4 and 12 were above the NEPA standard due to the fact that the water in these areas are regarded as brackish due to their proximity to the ocean and not full-strength freshwater. Average dissolved oxygen (D.O.) values at marine locations were all within acceptable levels (>4 mg/l) and above the level that may be considered detrimental to aquatic life (≤ 3 mg/l). The lowest D.O. values was recorded at Stations 4 and 12, which are both located in the mangrove forest which had a very low water level and stagnant water, hence the low D.O. value (Table 6-4).

PAR varied across stations ranging from a low of 434.21 uE/m^2/s at Station 7 to a high of 1169 uE/m^2/s at Station 11. The decrease in PAR with depth is expected as less light is able to penetrate the water column with increasing depth. Cloud cover, time of day and the presence of organic and inorganic material also affect the amount of PAR available. Light extinction calculated for specific stations with depths greater than 0.5 metres, ranged from 0.08 – 0.69. The highest average value was obtained at station 5 and the lowest average value was obtained at station 7. The extinction coefficient indicates the rate of loss of light with depth. Station 5 showed the greatest loss of light (0.69), which would indicate a moderate presence of particles (biological or non-biological) in the water column affecting light penetration.

Average pH values were considered normal for seawater and Stations 7 and 9 pH values were marginally non-compliant with the NRCA marine water quality standard. Water turbidity remained low for all marine stations but were elevated at the two brackish water stations (Stations 4 and 12) due to the muddy mangrove substrate and low water level.

Table 6-4 Average Physical water quality data

STN.	Temp. (°C)	Cond. (mS/cm)	Salinity (ppt)	pH	PAR (uE/cm/s)	Light Extinction	D.O. (mg/l)	Turbidity (NTU)	TDS (g/l)
		MARINE STATIONS							
1	30.02	55.31	36.78	8.36	529.92	0.19	5.32	1.06	35.39
2	29.94	54.83	36.39	8.28	936.67	-	5.08	1.43	35.08
3	30.10	55.03	36.55	8.29	1100.67	-	5.32	4.23	35.23
5	29.16	54.80	36.37	8.25	714.11	0.69	4.01	3.72	35.07
6	30.26	55.11	36.62	8.40	640.33	-	6.21	2.50	35.29
7	29.99	55.26	36.76	8.43	434.21	0.08	6.29	0.53	35.41
8	29.68	55.22	36.67	8.27	891.33	0.32	5.93	2.23	35.35
9	30.68	55.26	36.70	8.44	1010.67	-	8.21	5.93	35.37
10	29.78	54.15	35.83	8.29	676.33	-	6.68	1.33	34.90
11	30.15	54.55	36.17	8.10	1169.00	-	4.02	2.60	34.90
NRCA Marine Water Standard	-	-	-	*8 - 8.4*	-		-	-	-
		MANGROVE BRACKISH/FRESHWATER STATIONS							
4	28.73	38.10	24.59	8.05	-	-	1.38	210.50	24.35
12	25.86	3.81	2.07	8.01	-	-	1.26	82.70	2.43
NRCA Ambient Freshwater Standard	-	*0.15 – 0.6*	-	*7 – 8.4*	-	-	-	-	*0.12 – 0.3*

Values in red were non-compliant with their respective NRCA Standard.

Average BOD values were non-compliant with the NRCA standards for all station sampled (Table 6-5). Average faecal coliform values were elevated at most stations; Stations 7 and 8 had the lowest average faecal coliform values and were both compliant with the NRCA marine coliform standard. Elevated BOD and faecal coliform values may be as a result of anthropogenic influences in the form of pollution via solid waste dumping and untreated sewage effluent discharge/disposal (nearby septic tanks and absorption pits).

TSS values at marine stations mirror the turbidity values and remained low, indicating clear water. TSS values at the mangrove stations were elevated due the nature of the substrate and low water level. Nitrate and phosphate values at all marine stations sampled were non-compliant with the NRCA marine standard; however, these nutrient values are considered normal for Jamaican coastal waters and seldom vary outside of this range. Average Faecal Enterococcus bacteria were elevated at marine Stations 10 and 11, as well as the mangrove stations 4 and 12.

The majority of the marine stations sampled showed no traces of Total Petroleum Hydrocarbons (TPH). Marine stations that exhibited traces of TPH were: Station 1 (DRO 0.13 mg/l), Station 6 (DRO 0.15 mg/l) and Stations 11 (DRO 0.17 mg/l). Both stations 4 and 12 located in the mangroves exhibited traces of TPH; Station 4 (DRO – 2.55 mg/l and ORO – 10 mg/l), Station 12 (DRO – 0.19 mg/l) (Table 6-5).

Table 6-5 Average biochemical water quality data

STN.	BOD (mg/l)	TSS (mg/l)	Nitrate (mg/l)	Phosphate (mg/l)	Faecal Coliform (MPN/100ml)	Enterococcus (MPN/100ml)	TPH - GRO C6-C10 (mg/l)	TPH – DRO C10-C28 (mg/l)	TPH – ORO C28-C35 (mg/l)
1	2.32	<5	2.00	0.13	37.33	4.75	ND	**0.13**	ND
2	1.66	<5	1.17	0.27	84.00	2.85	ND	ND	ND
3	1.47	<5	1.20	0.11	60.67	<1.8	ND	ND	ND
5	1.84	<5	1.47	0.10	83.33	9.4	ND	ND	ND
6	1.54	<5	1.57	0.05	37.33	6.85	ND	**0.15**	ND
7	1.34	<5	1.33	0.11	<11	<1.8	ND	ND	ND
8	1.52	<5	1.17	0.12	<11	<1.8	ND	ND	ND
9	2.15	6.67	1.97	0.12	24.33	<1.8	ND	ND	ND
10	1.62	<5	1.27	0.26	84	128.5	ND	ND	ND
11	1.46	<5	0.83	0.09	87.33	108	ND	**0.17**	ND
Marine Water Standard	*1.16*	-	*0.007 – 0.014*	*0.001-0.003*	*<2 - 13*	-	-	-	-
4	49.99	1006.5	3.1	1.03	1585	>1600	ND	**2.55**	**10**
12	34.52	38.67	2.6	0.25	203	260	ND	**0.19**	ND
Ambient Freshwater Standard	*0.8 – 1.7*	-	*0.1 – 7.5*	*0.01-0.8*	-	-	-	-	-

Values in red were non-compliant with their respective NRCA Standard.

ND – None Detected

6.1.12 Sedimentology

6.1.12.1 Sieve Analysis

Five (5) sand samples were collected from the beach and sieve analysis conducted on each sample. All samples were light brown coralline sand indicating high calcium content. Samples 1, 3, and 5 are suitable for use on the beach but there is only a small amount of sand available. Results of the sand probing exercise indicate only 0.6m of sand is available in these areas.

Figure 6-33 shows where samples were collected and Table 6-6 summarises the sieve analysis results.

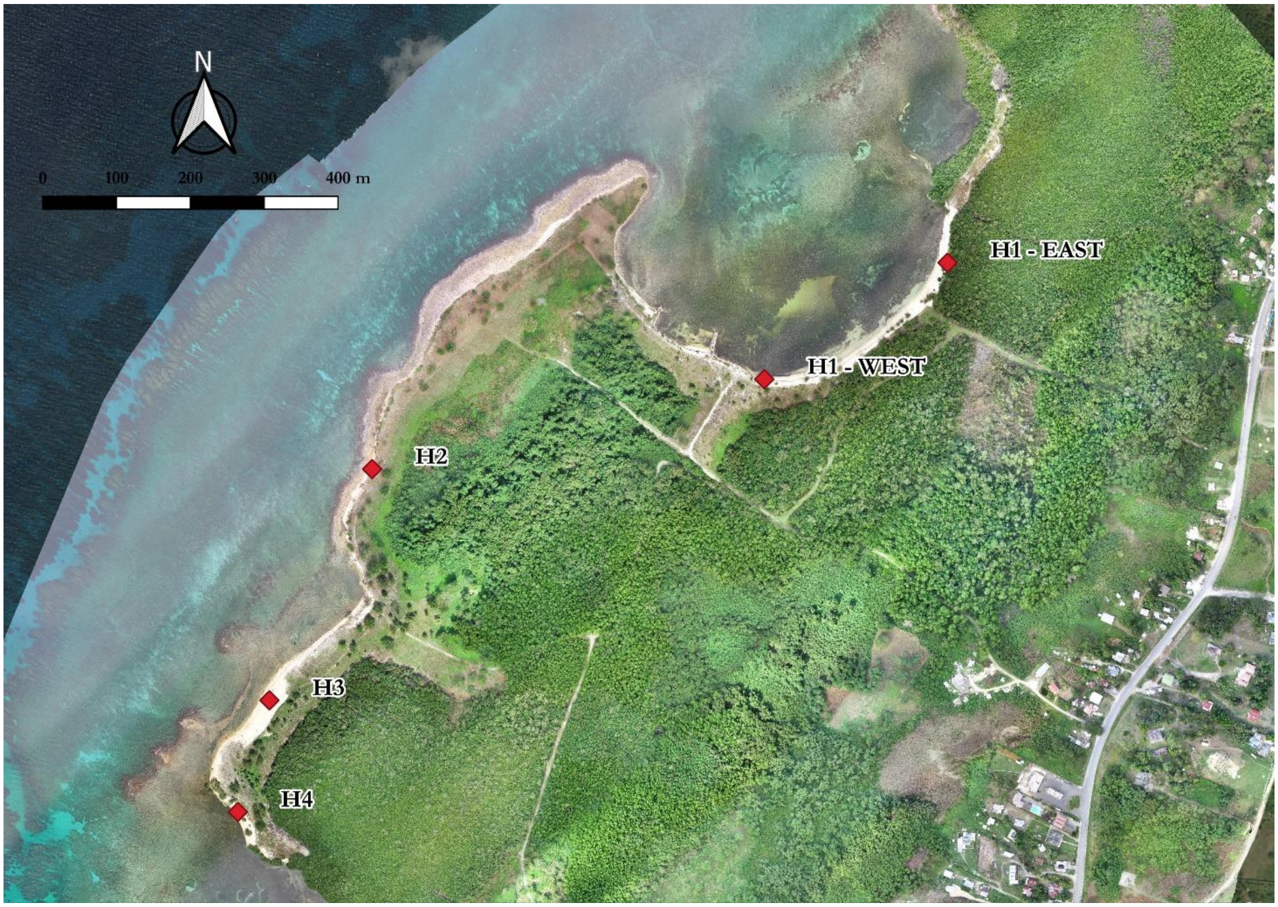


Figure 6-33 Locations of sand samples for sieve analysis

Table 6-6 Sand sieve analysis results

Sample	Mean Grain Size (mm)	Description	Percentage Silt (%)	Uniformity Coefficient	Standard Deviation
H1 – EAST	0.656	*Coarse Sand* Well Sorted	0	1.777	0.404
H1 – WEST	0.315	*Medium sand* Moderately Sorted	0	2.383	0.765
H2	0.722	*Coarse Sand* Well Sorted	0.11%	1.710	0.403
H3	1.165	*Very Coarse Sand* Moderately Well Sorted	0	2.123	0.654
H4	0.979	*Coarse Sand* Moderately Sorted	0	1.971	0.865

6.1.12.2 Hydraulic Probing

A water jet was used to probe the sea bottom at several locations along the shoreline and in the nearshore. This procedure determines the depth of silty or sandy material below the seabed. The probe is pushed into the seabed until it reaches hard/rocky material. The investigation informs areas that can be easily deepened and, in some cases, potential sources of sand. Sand for beach works will either be imported from the Bahamas or manufactured sand used.

Hydraulic probing also gives a preliminary indication of the kind of foundation possible for marine structures, especially for pilings. The probing exercise led to the following conclusions:

- The eastern end of the cove has a thick layer of loose sediment (probably silt). In this area, currents are low and therefore fine sediments settle.
- Eastward the probe went 0.6-1.5m before hitting hard material. This suggests that piling will encounter a hard layer just below the seabed. Detailed geotechnical borings will be necessary.
- Along the sandy beach, loose sediment is 0.6-1.8m thick. This is a suitable amount of sand for a resort however the beach is quite narrow. More sand will be required to widen the beach.
- Moving towards the west end of the property (Hotels 2-4), the shoreline gets harder with less than 0.6m of loose sediment. These areas will have to be excavated and filled with suitable sand. Unless sand can be found landward of the beach, the sand needed for nourishing the proposed beaches will have to be sourced externally.

Figure 6-34 and Figure 6-35 show locations and results of the sand probing exercise.

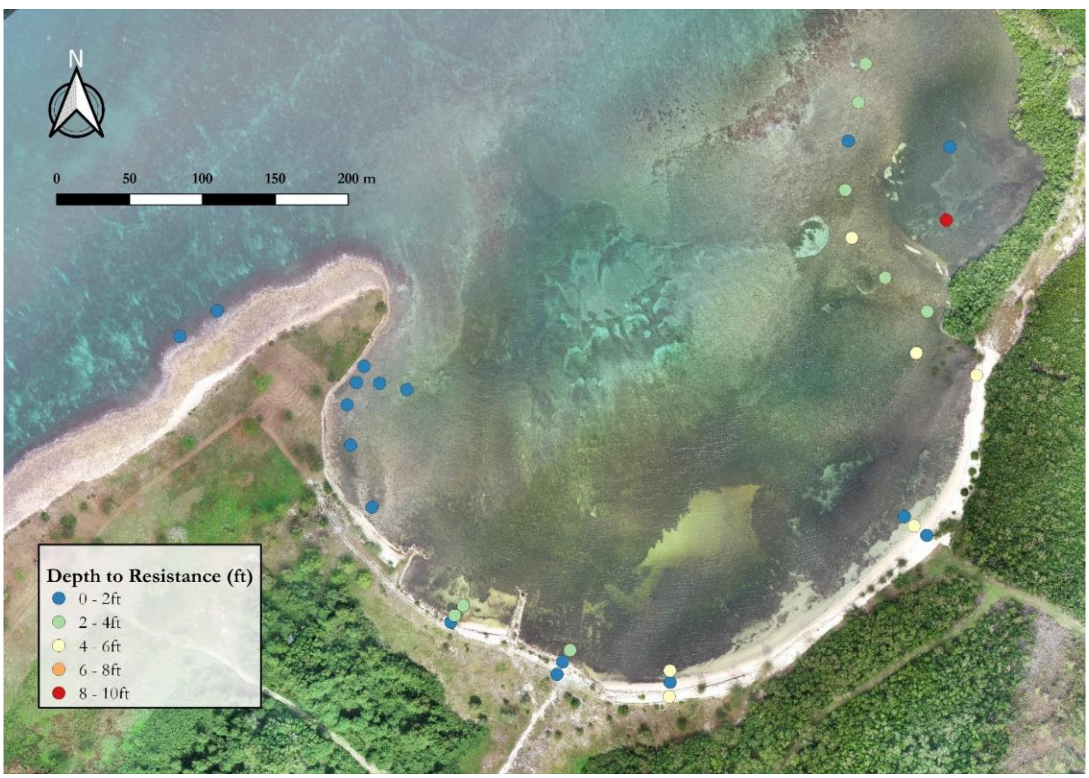


Figure 6-34 Probe depths at Hotels 1 and 2 (north-eastern end of property)

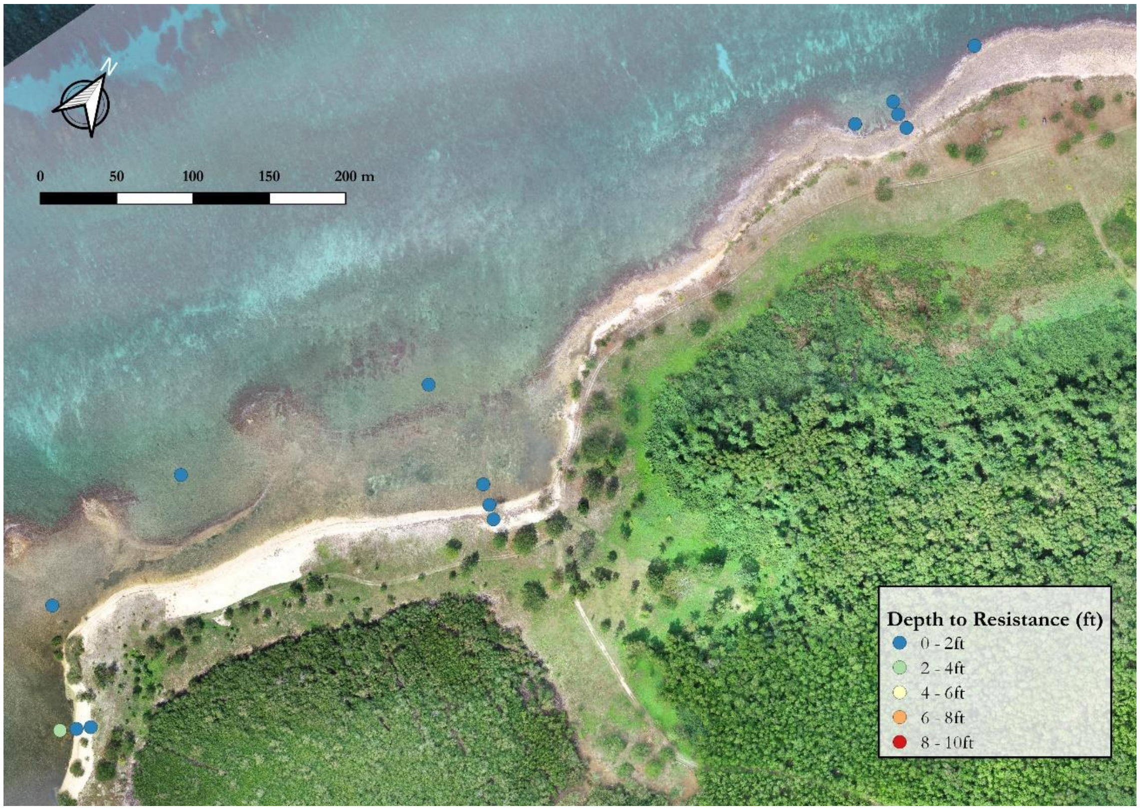


Figure 6-35 Probe depths at Hotels 3 and 4 (south-western end of property)

6.1.12.3 Benthic Sediment Chemistry

Methodology

Six (6) sediment samples were taken using a sediment grab sampler on September 19th, 2019 and analysed for the heavy metals (Pb - lead, As - Arsenic, Cd - Cadmium, Hg - Mercury) and Total Petroleum Hydrocarbons - Gasoline Range Organics (GRO C6-C10), Diesel Range Organics (DRO C10-C28) and Oil Range Organics (ORO C28-C35). The sediment sampling locations are shown in Table 6-7 and Figure 6-36. The samples were stored on ice in a cooler and transported to Test America Pensacola Laboratory in Florida for analyses.

Table 6-7 Marine benthic sediment sampling locations (JAD2001)

STATION #	LOCATION (JAD2001)	
	NORTHINGS	EASTINGS
PS1	696129.864	616475.753
PS2	696045.576	616526.326
PS3	695884.223	616343.299
PS4	696021.624	616132.315
PS5	695623.892	615685.849
PS6	695135.019	615628.051

Figure 6-36 Marine benthic sediment sampling locations

Results

Table 6-8 displays the sediment sampling results for the parameters at the various sampling locations. No cadmium was detected in any of the samples taken. Arsenic values ranged from a low of 3.5 mg/kg at Station PS1 to 15 mg/kg at Station PS2, while lead values ranged from a low of 2.9 mg/kg at Station PS1 to a high of 6.5 mg/kg at Station PS2. Mercury was detected at Station PS2 (0.041 mg/kg) and Station PS3 (0.056 mg/kg) only. When these metal concentrations were compared to the average levels found in Jamaican soil (Table 6-9), all current values were below the reported average for each metal.

No Gasoline Range Organics were detected in any of the samples taken. However, Diesel Range Organics were detected at all sampling stations, except Stations PS1 and PS6, and ranged from a low of 17 mg/kg at Station PS2 to a high of 100 mg/kg at Station PS4. Oil Range Organics were detected at all sampling stations, except Stations PS1 and PS6, and ranged from a low of 44 mg/kg at Station PS3 to a high of 62 mg/kg at Station PS4. TPH analysis could not be conducted on Station sample PS5 due to insufficient sample to run the requisite tests due to this station being located on pavement substrate.

Table 6-8 Marine benthic sediment values

STATION	Arsenic (mg/kg)	Cadmium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	TPH - Gasoline Range Organics (C6 – C10) (mg/kg)	TPH - Diesel Range Organics (C10-28) (mg/kg)	TPH - Oil Range Organics (C28-C35) (mg/kg)
PS1	3.5	ND	2.9	ND	ND	ND	ND
PS2	15	ND	6.5	0.041	ND	17	47
PS3	12	ND	3.9	0.056	ND	24	44
PS4	8.3	ND	5.7	ND	ND	100	62
PS5	9.0	ND	3.8	ND	-	-	-
PS6	5.1	ND	6.1	ND	ND	ND	ND

ND – None Detected

Table 6-9 Metal Concentrations in Jamaican Soil

Metal	Avg. Concentration (mg/KG)	Range (mg/Kg)	95th Percentile (mg/KG)
Arsenic	25	1.4-203	<64.9
Cadmium	20	0.2-409	<77.6
Lead	46.5	6-897	<90
Mercury	0.2	0.04-0.83	<0.46

Source: A geochemical atlas of Jamaica, Centre for Nuclear Sciences, UWI, 1995, Canoe Press.

COMPARISON TO OTHER NEARBY LOCATIONS (LONG BAY AND BLOODY BAY NEGRIL)

When these results were compared to the chemical levels found in sediments in Long Bay, Negril taken for the Negril Breakwaters EIA, as well as in Bloody Bay taken for the Royalton Negril Hotel Technical Report, values were somewhat similar. Arsenic values were on average, higher at the project site compared to Long Bay and Bloody Bay (Table 6-10 and Table 6-11). Cadmium and Lead results were similar for all three sites. No traces of mercury were found at Long Bay or Bloody Bay, while Stations PS2 and PS3 at the project site had traces of mercury. Regarding Total Petroleum Hydrocarbons, DRO values were similar between the project site and Bloody Bay; however, no traces of GRO were detected at the project site while traces were detected at Bloody Bay.

Table 6-10 Negril Breakwater Long Bay EIA sediment analysis results

Station	Arsenic (mg/KG)	Cadmium (mg/KG)	Lead (mg/KG)	Mercury (mg/KG)	TPH (mg/KG)
S1	1.1	ND	0.93	ND	140
S2	4.5	ND	1.4	ND	1100
S3	4.2	ND	ND	ND	770
S4	3	ND	4.4	ND	420
S5	1.4	ND	1.5	ND	ND
S6	ND	ND	1.2	ND	ND
S7	1.8	ND	5	ND	ND

Table 6-11 Royalton Negril Bloody Bay Technical Report sediment analysis results

STATION	Arsenic (mg/kg)	Cadmium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	TPH - Gasoline Range Organics (C6 – C10) (mg/kg)	TPH - Diesel Range Organics (C10-28) (mg/kg)
STN 2	1.2	ND	1.5	ND	0.25	20
STN 3	1.6	ND	2.1	ND	0.23	23
STN 5	1.7	ND	1.6	ND	0.12	ND
STN 8	2.4	ND	1.7	ND	ND	ND
STN 10	5.1	ND	1.8	ND	0.15	ND

6.1.12.4 Marine Sedimentation Rate

Methodology

Baseline sedimentation data were collected using sediment traps. A total of fifteen (15) sediment traps were deployed in and around the project area. The traps were retrieved after 28 days and its contents analysed to determine the rate of sedimentation (mg/cm^2/day) in the area. The sediment trap dimensions were approximately 21.4” (54.3 cm) long with an internal diameter of 3” (7.6 cm) (Plate 6-3, Plate 6-4 and Plate 6-5). Sediment traps were taken to the Caribbean Environmental Testing and Monitoring Services Limited for analysis.

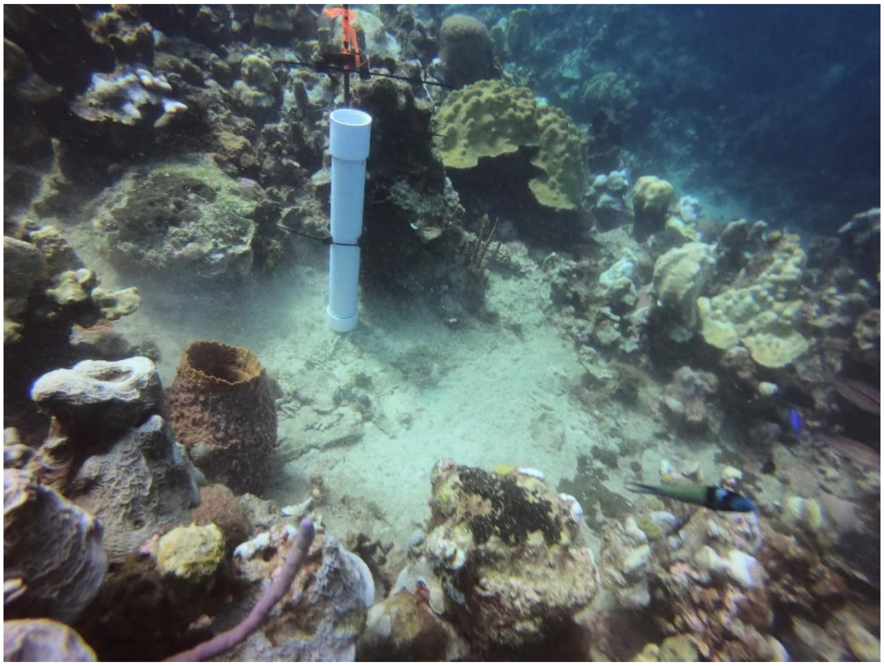


Plate 6-3 Sediment Trap deployed offshore

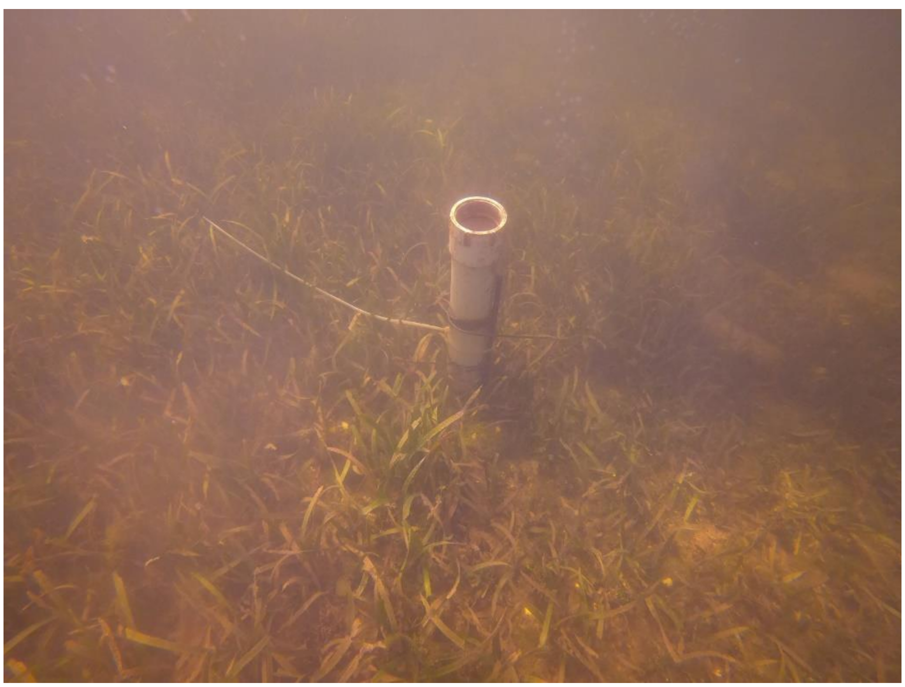


Plate 6-4 Sediment Trap deployed nearshore at Station S5

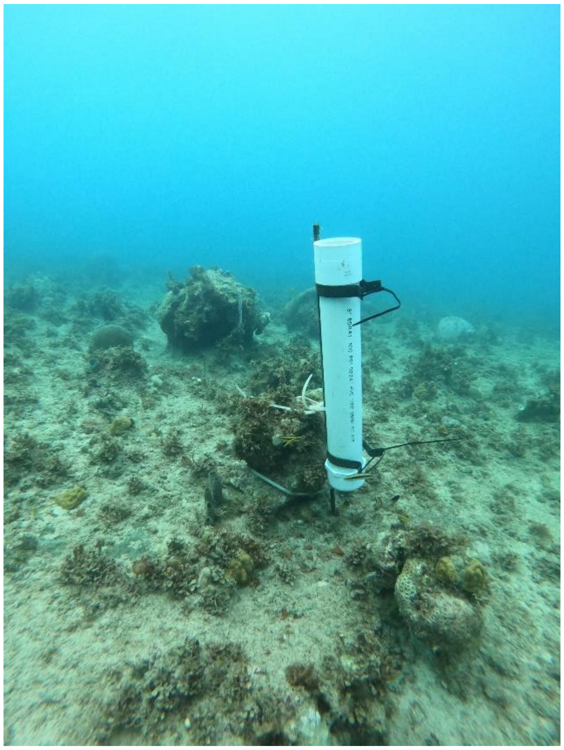


Plate 6-5 Sediment Trap deployed offshore

The contents of the sediment traps were filtered through a filter paper, dried and then weighed. The results are represented in the form of "Mass of Sediment Recovered". Using the results retrieved from the laboratory, the sedimentation rate per day (mg/cm^2/day) was calculated by dividing the mass of sediment recovered by the number of days deployed and the area of the sediment trap opening.

Sedimentation Rate per day = *Mass of Sediment Recovered* / *(# of days deployed)* x *(area of trap opening)*

Sediment traps were deployed between September 26th and October 11th, 2019 and all were retrieved on November 3rd, 2019. Table 6-12 gives the coordinates and Figure 6-37 shows a map of the sediment trap locations.

Table 6-12 Sediment Trap location coordinates

STATION #	LOCATION (JAD2001)	
	NORTHINGS	EASTINGS
S1	697079.131	616265.138
S2	696877.947	616372.176
S3	696520.020	616431.906
S4	696165.054	616550.152
S5	695973.522	616350.638
S6	696071.283	616222.950

STATION #	LOCATION (JAD2001)	
	NORTHINGS	EASTINGS
S7	696234.407	615813.520
S8	696495.627	615671.153
S9	696166.878	615148.476
S10	695865.447	615478.954
S11	694920.338	614659.595
S12	694843.958	614893.814
S13	694632.049	615506.105
S14	695104.934	615672.791
S15	694261.907	615699.827

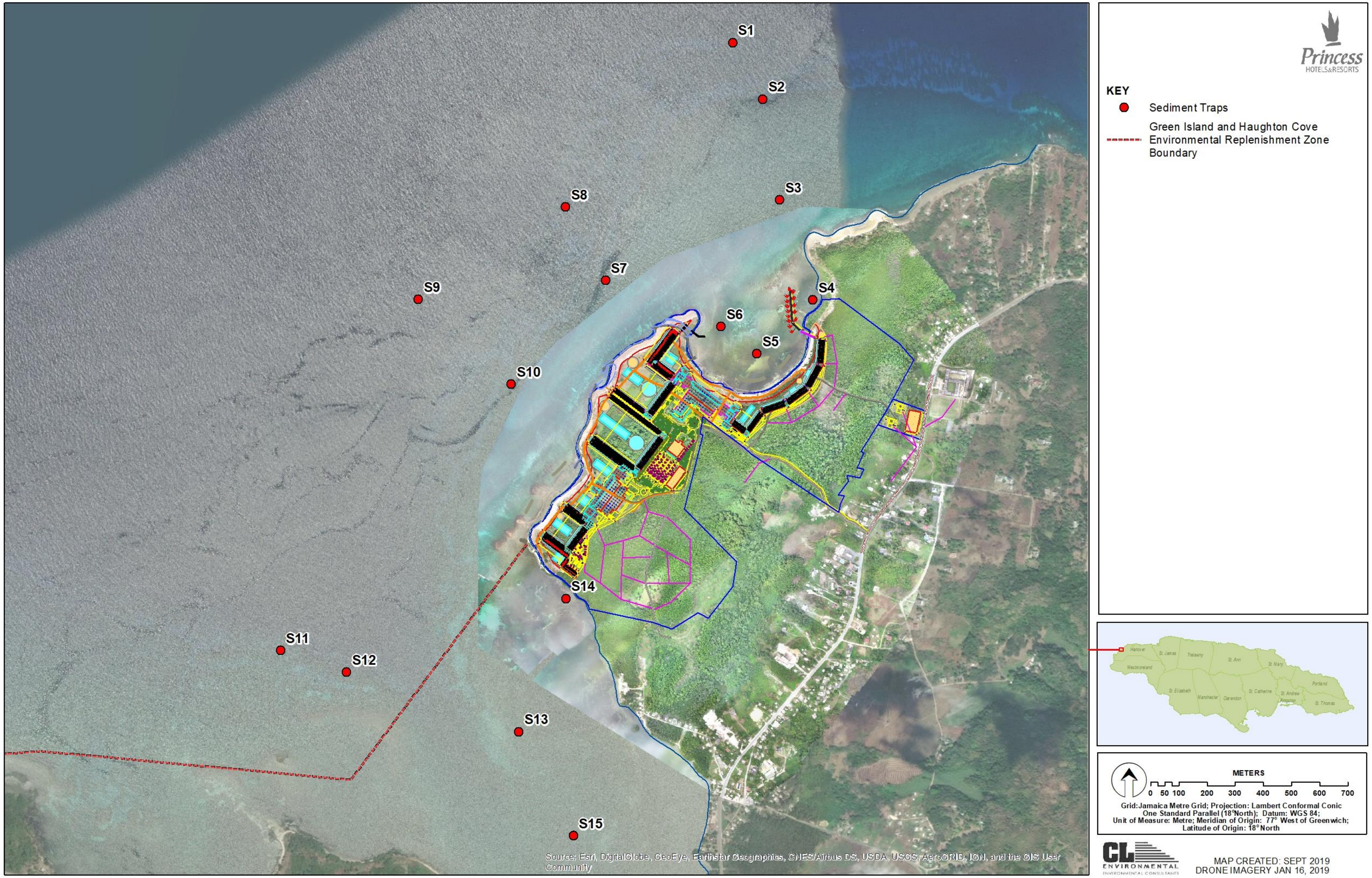


Figure 6-37 Sediment Trap locations

Results

Table 6-13 shows the sedimentation rates for the assessment period. Sedimentation rates ranged from a low of 0.0002 $mg/cm^2/day$ at Station S2 and S12, to a high of 0.047 $mg/cm^2/day$ at Station S4. The highest sedimentation rates were observed at Stations S4, S5, S6 and S14. These stations were all located nearshore and in the shallowest water of all the stations sampled. Stations in shallow water will tend to have, on average, higher sedimentation rates than those in the deeper waters due to the wave climate and subsurface currents having a greater effect on the stirring up of sediments in shallow depths, and thus the sedimentation rates.

Stations S4, S5 and S6 are all located nearshore inside of Negro Bay, while Station S14 is located near to the mouth of a drain located at the southern-most point of the project property. In addition to being in a shallow area, Station S14 may also be affected by increased land-based sediments resulting from discharge of this nearby drain.

Table 6-13 Sedimentation Rates at each Location

Sediment Trap Locations	Mass of Sediment Recovered (mg)	Area of trap opening (cm^2)	Deployment date	Retrieval date	# of days deployed	Sedimentation Rate ($mg/cm^2/day$)
S1	5.0	45.61	11.10.19	03.11.19	23	**0.004**
S2 (Transect 4)	0.25	45.61	11.10.19	03.11.19	23	**0.0002**
S3	1.24	45.61	11.10.19	03.11.19	23	**0.001**
S4	79.4	45.61	27.09.19	03.11.19	37	**0.047**
S5	74.4	45.61	27.09.19	03.11.19	37	**0.044**
S6	37.2	45.61	27.09.19	03.11.19	37	**0.022**
S7 (Transect 3)	9.92	45.61	11.10.19	03.11.19	23	**0.009**
S8	0.5	45.61	11.10.19	03.11.19	23	**0.0004**
S9	1.5	45.61	11.10.19	03.11.19	23	**0.001**
S10 (Transect 2)	18.6	45.61	26.09.19	03.11.19	38	**0.011**
S11	2.48	45.61	26.09.19	03.11.19	38	**0.001**
S12 (Transect 1)	0.25	45.61	11.10.19	03.11.19	23	**0.0002**
S13	17.36	45.61	27.09.19	03.11.19	37	**0.01**
S14	62.0	45.61	27.09.19	03.11.19	37	**0.037**
S15	22.32	45.61	26.09.19	03.11.19	38	**0.013**

Stations S2, S7, S10 and S12 were also the locations of coral reef monitoring transects

6.1.13 Ambient Noise

6.1.13.1 Methodology

Noise level readings were taken from 7:00am Friday March 8th, 2019 to 7:00am Monday March 11th, 2019, by using a combination of Brüel & Kjaer noise analysers and Quest Technologies SoundPro DL Type 1 hand held sound level meters with real time frequency analyser setup in outdoor monitoring kits. The octave band analysis was conducted concurrently with the noise level measurements. Measurements were taken in the third octave which provided thirty-three (33) octave bands from 12.5 Hz to 20 kHz (low, medium and high frequency bands).

The noise meters were calibrated pre-and post-noise assessment by using a Brüel & Kjaer Type 4231 sound calibrator and a Quest QC - 10 sound calibrator (Appendix 5). The meters were programmed to collect third octave, average sound level (Leq) over the period, Lmin (The lowest level measured during the assessment) and Lmax (The highest level measured during the assessment) every ten seconds.

Seven (7) noise meters with outdoor monitoring kits were set up. Table 6-14 and Figure 6-38 lists and shows the locations of the noise monitoring stations. These meters were left for the entire seventy-two (72) hour assessment period in an outdoor measuring system (Plate 6-6) and programmed to collect data every 10 seconds. A windscreen (sponge) was placed over the microphone to prevent measurement errors due to noise caused by wind blowing across the microphone. The microphone of the meters was at a height of approximately 1.5m above ground. There were no vertical reflecting surfaces within 3 m (10 feet) of the microphone. Noise statistics (L_{10} and L_{90}) were also calculated at each location.

Table 6-14 Noise and particulate monitoring location coordinates (JAD2001)

STATION #	LOCATION (JAD2001)	
	NORTHINGS	EASTINGS
NP1	696001.662	616915.461
NP2	695434.923	616632.885
NP3	695882.599	616567.798
NP4	695742.899	616191.559
NP5	695907.999	615902.634
NP6	695217.436	615626.937
NP7	695009.473	615986.772

Plate 6-6 Photo showing noise meter setup on project site

Figure 6-38 Location of noise and particulate monitoring stations

6.1.13.2 Results

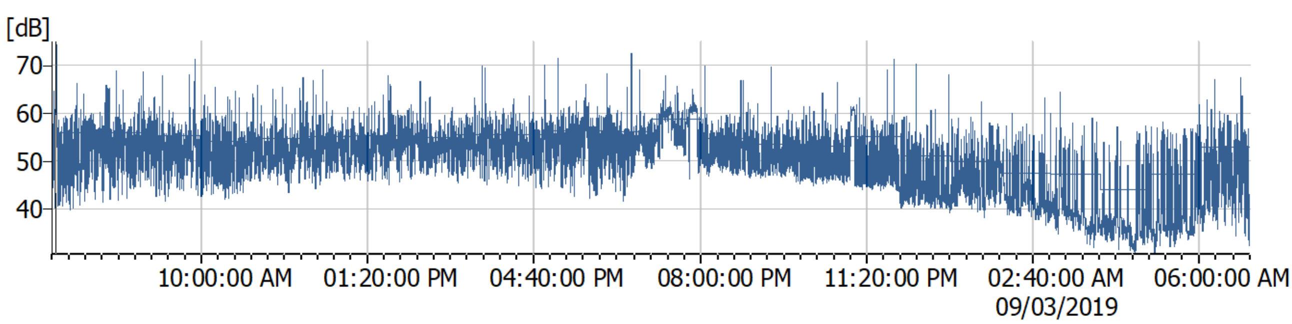
Table 6-15 shows the minimum, maximum and average noise levels over the 72-hour assessment period, as well as the geometric mean centre frequencies obtained at each station.

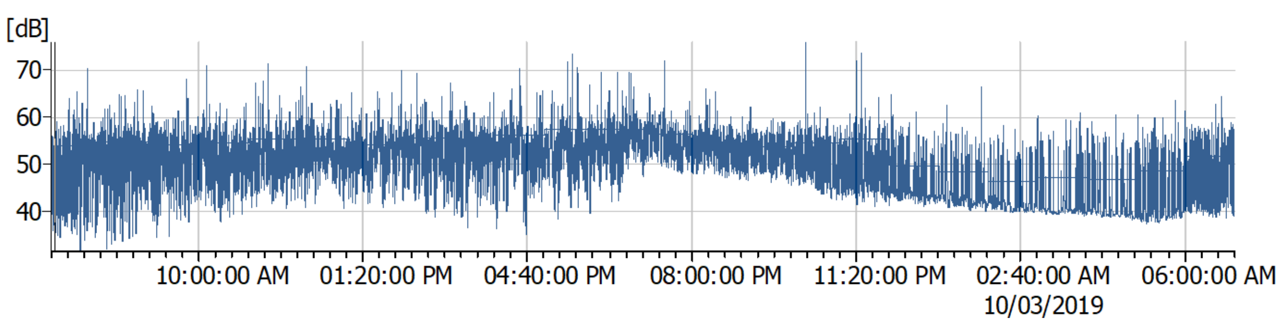
Table 6-15 Ambient Noise data at all stations

Stn.#	Average Leq (72 hr)	Min (dBA)	Max (dBA)	Geometric Centre Frequency (Hz)	Octave Band Range (Hz)
N1	54.1	26.7	84.3	12.5	11-14
N2	54.9	27.7	85.2	12.5	11-14
N3	48.2	29.3	72.6	12.5	11-14
N4	51.8	30.1	78.2	12.5	11-14
N5	50.4	33.7	76.6	12.5	11-14
N6	61.3	29.9	88.2	25	22-28
N7	48.1	28.8	67.5	12.5	11-14

STATION 1

During the 72-hour period, noise levels at this station ranged from a low (Lmin) of 26.7 dBA to a high (Lmax) of 84.3 dBA. Average noise level for this period was 54.1 L_{Aeq} (72h). The fluctuation in noise levels over the 72-hour period is depicted in Figure 6-39.





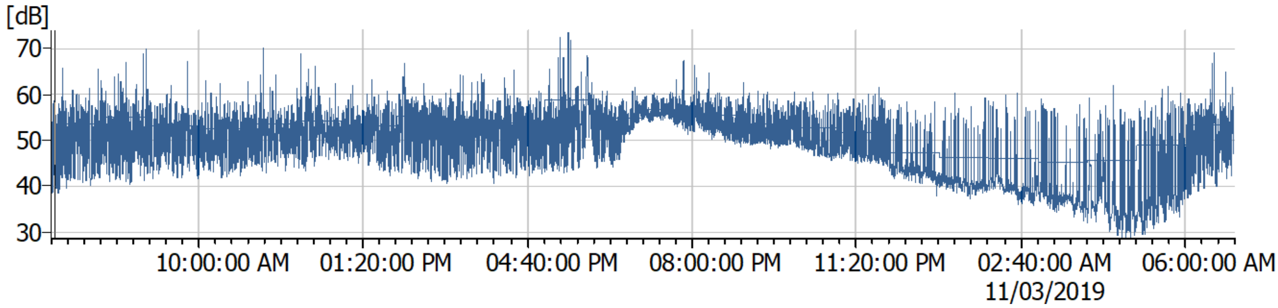
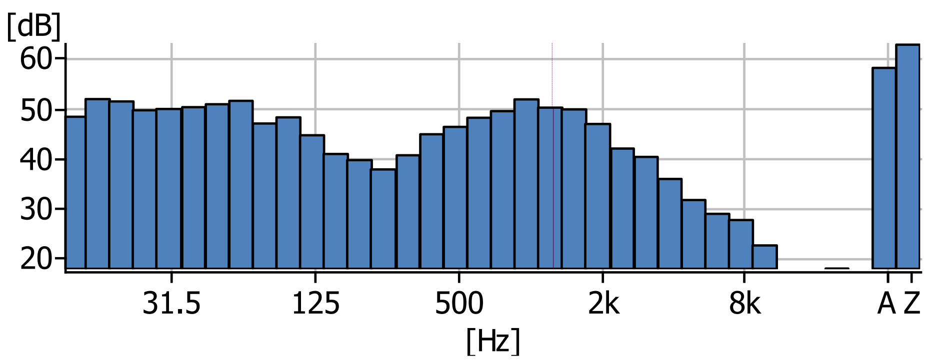
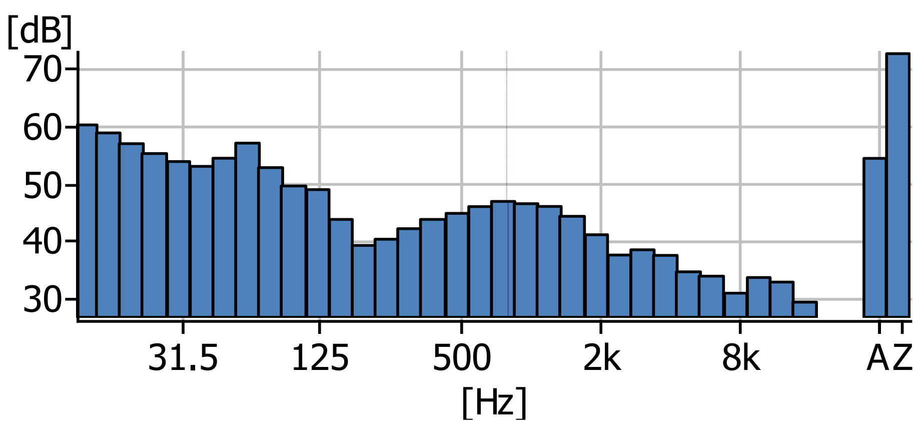


Figure 6-39 Noise fluctuation (Leq) over 72 hours at Station 1 (top: March 8-9, middle: March 9-10, bottom: March 10-11)

OCTAVE BAND ANALYSIS AT STATION 1

The noise at this station during the 72-hour period was in the low frequency band with a dominant geometric mean frequency of 12.5 Hz. (octave frequency range is 11 - 14 Hz) (Figure 6-40).





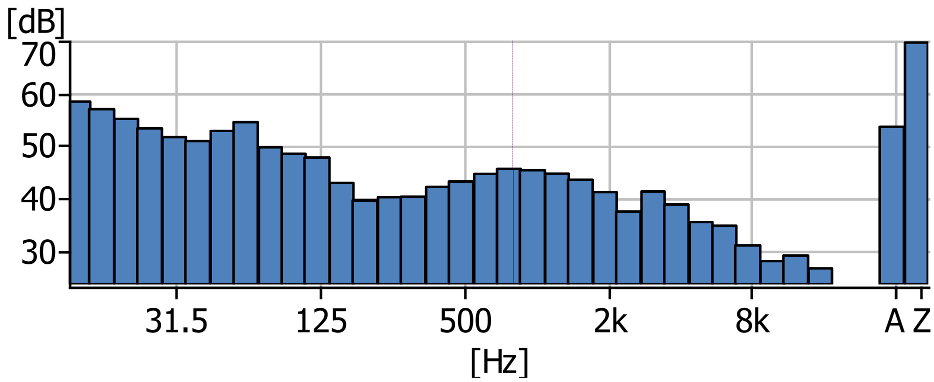


Figure 6-40 Octave band spectrum of noise at Station 1 (top: March 8-9, middle: March 9-10, bottom: March 10-11)

L10 AND L90

The two most common **L_n** values used are **L_{10}** and **L_{90}** and these are sometimes called the 'annoyance level' and 'background level' respectively. **L_{10}** is almost the only statistical value used for the descriptor of the higher levels, but **L_{90}**, is widely used to describe the ambient or background level. L10-L90 is often used to give a quantitative measure as to the spread or "how choppy" the sound was.

L10 is the noise level exceeded for 10% of the time of the measurement duration. This is often used to give an indication of the upper limit of fluctuating noise, such as that from road traffic. L90 is the noise level exceeded for 90% of the time of the measurement duration.

The difference between L10 and L90 gives an indication of the noise climate. When the difference is < 5 dBA then it is considered that there are no significant fluctuations in the noise climate, moderate fluctuations 5-15 dBA and large fluctuations >15 dBA.

Figure 6-41 depicts the hourly L10 and L90 statistics for this station over the noise assessment period. The data shows moderate fluctuations (L10 – L90) (≈78 % of the time), large fluctuations (L10 – L90) (≈21 % of the time) and no significant fluctuations (L10 – L90) (≈1 % of the time) in the noise climate at this station.

The overall L10 and L90 at this station for the time assessed were 57.31 dBA and 39.76 dBA respectively.

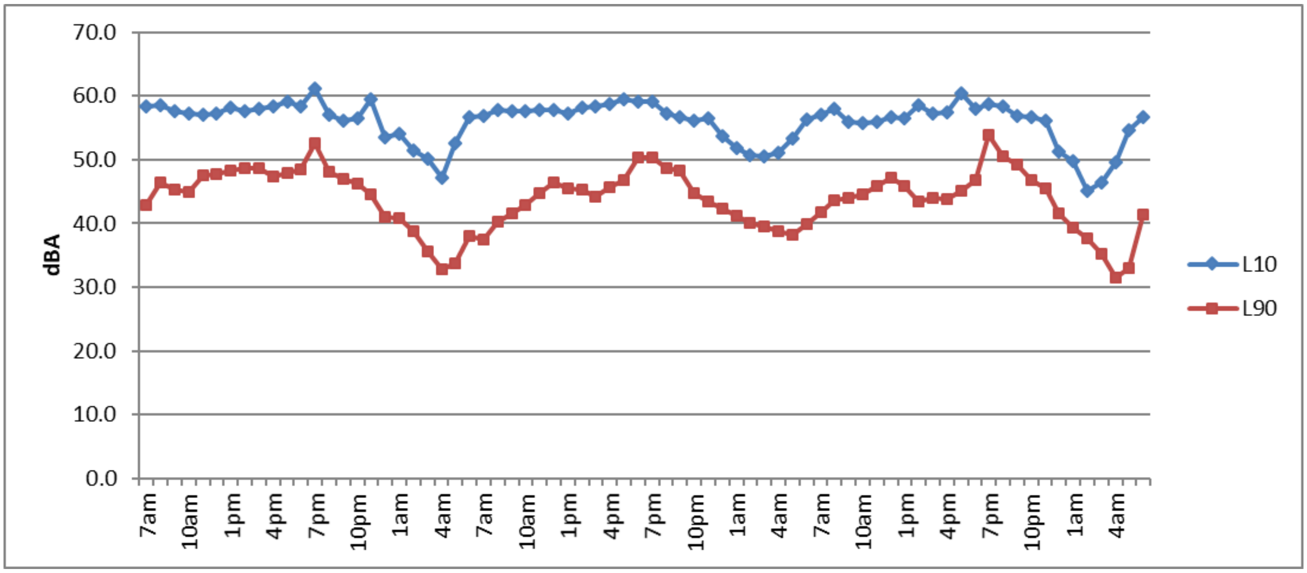
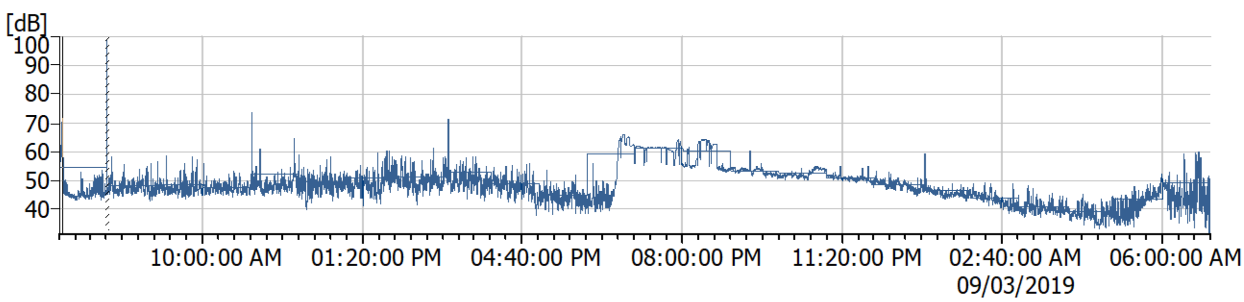
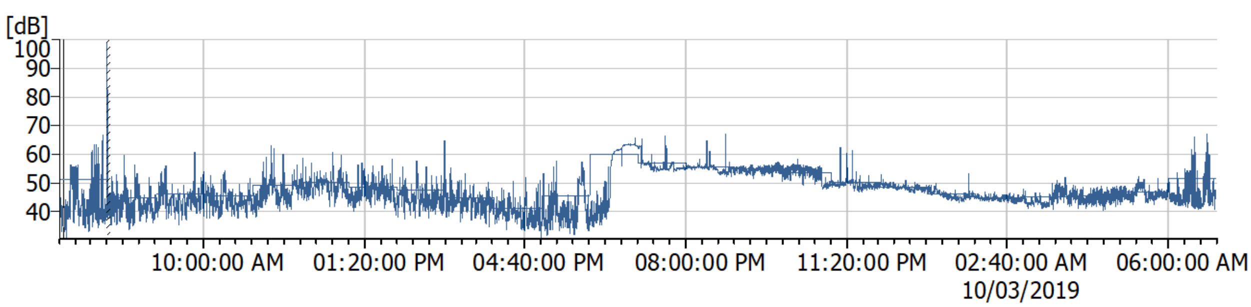


Figure 6-41 L10 and L90 for Station 1

STATION 2

During the 72-hour period, noise levels at this station ranged from a low (Lmin) of 27.7 dBA to a high (Lmax) of 85.2 dBA. Average noise level for this period was 54.9 L_{Aeq} (72h). The fluctuation in noise levels over the 72-hour period is depicted in Figure 6-42.





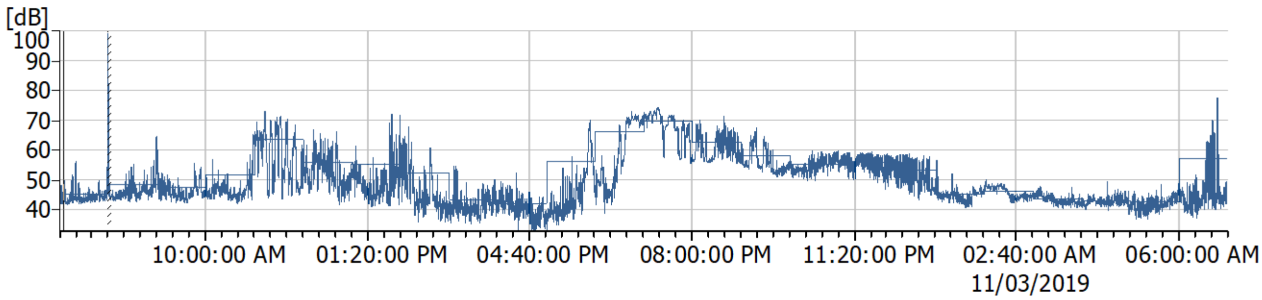
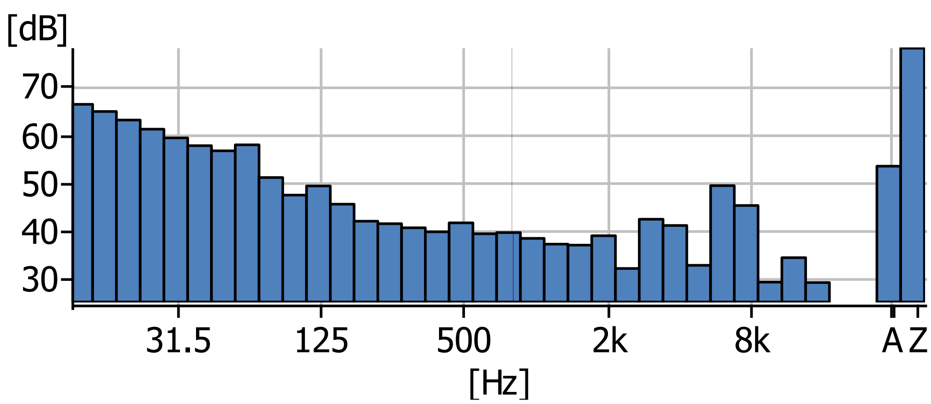
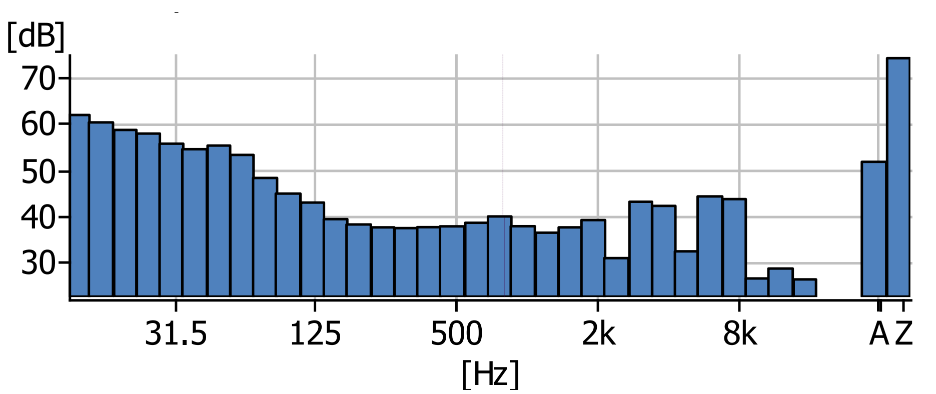


Figure 6-42 Noise fluctuation (Leq) over 72 hours at Station 2 (top: March 8-9, middle: March 9-10, bottom: March 10-11)

OCTAVE BAND ANALYSIS AT STATION 2

The noise at this station during the 72-hour period was in the low frequency band with a dominant geometric mean frequency of 12.5 Hz. (octave frequency range is 11 - 14 Hz) (Figure 6-43).





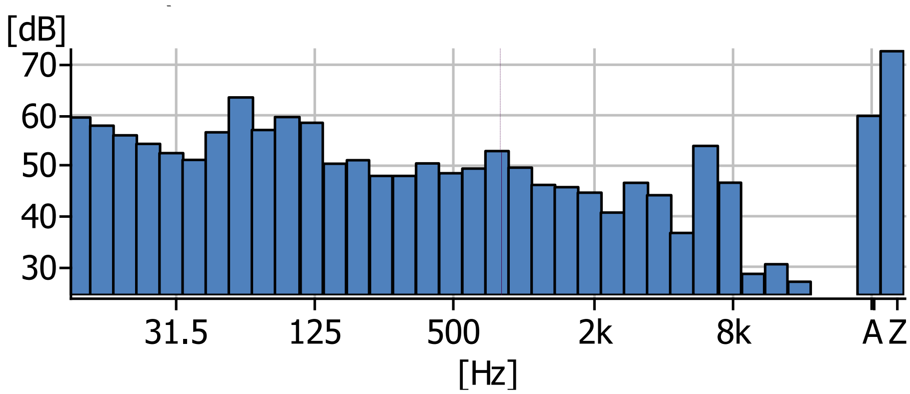


Figure 6-43 Octave band spectrum of noise at Station 2 (top: March 8-9, middle: March 9-10, bottom: March 10-11)

L10 AND L90

Figure 6-44 depicts the hourly L10 and L 90 statistics for this station over the noise assessment period. The data shows moderate fluctuations (L10 – L90) (≈60% of the time), no significant fluctuations (L10 – L90) (≈29% of the time) and large fluctuations (L10 – L90) (≈11% of the time) in the noise climate at this station. The overall L10 and L 90 at this station for the time assessed were 57.04 dBA and 40.57 dBA respectively.

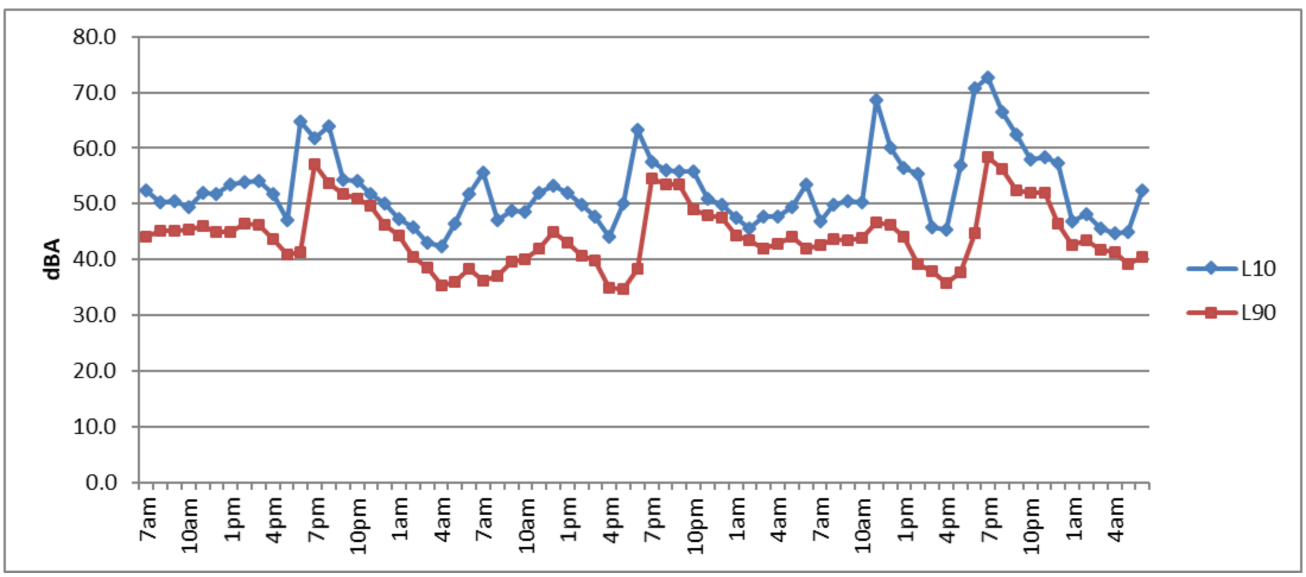


Figure 6-44 L10 and L90 for Station 2

STATION 3

During the 72-hour period, noise levels at this station ranged from a low (Lmin) of 29.3 dBA to a high (Lmax) of 72.6 dBA. Average noise level for this period was 48.2 L_{Aeq} (72h). The fluctuation in noise levels over the 72-hour period is depicted in Figure 6-45.

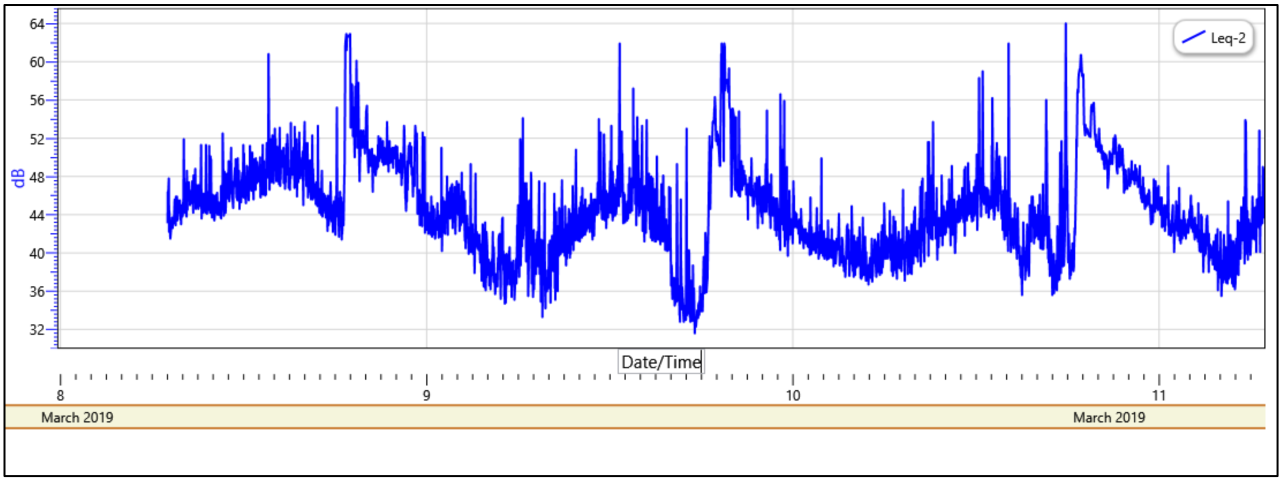


Figure 6-45 Noise fluctuation (Leq) over 72 hours at Station 3

OCTAVE BAND ANALYSIS AT STATION 3

The noise at this station during the 72-hour period was in the low frequency band centred around the geometric mean frequency of 12.5 Hz. (octave frequency range is 11 - 14 Hz) (Figure 6-46).

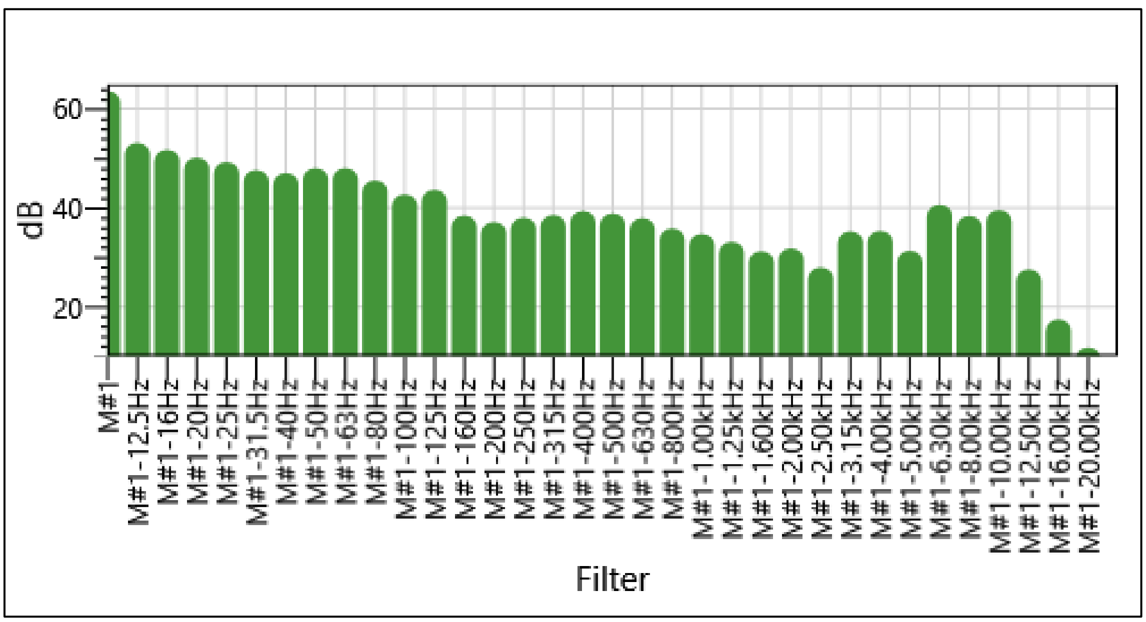


Figure 6-46 Octave band spectrum of noise at Station 3

L10 AND L90

Figure 6-47 depicts the hourly L10 and L90 statistics for this station over the noise assessment period. The data shows moderate fluctuations (L10 – L90) (≈28% of the time), no significant fluctuations (L10 – L90) (≈68% of the time) and large fluctuations (L10 – L90) (≈4% of the time) in the noise climate at this station. The overall L10 and L90 at this station for the time assessed were 50.6 dBA and 38.1 dBA respectively.

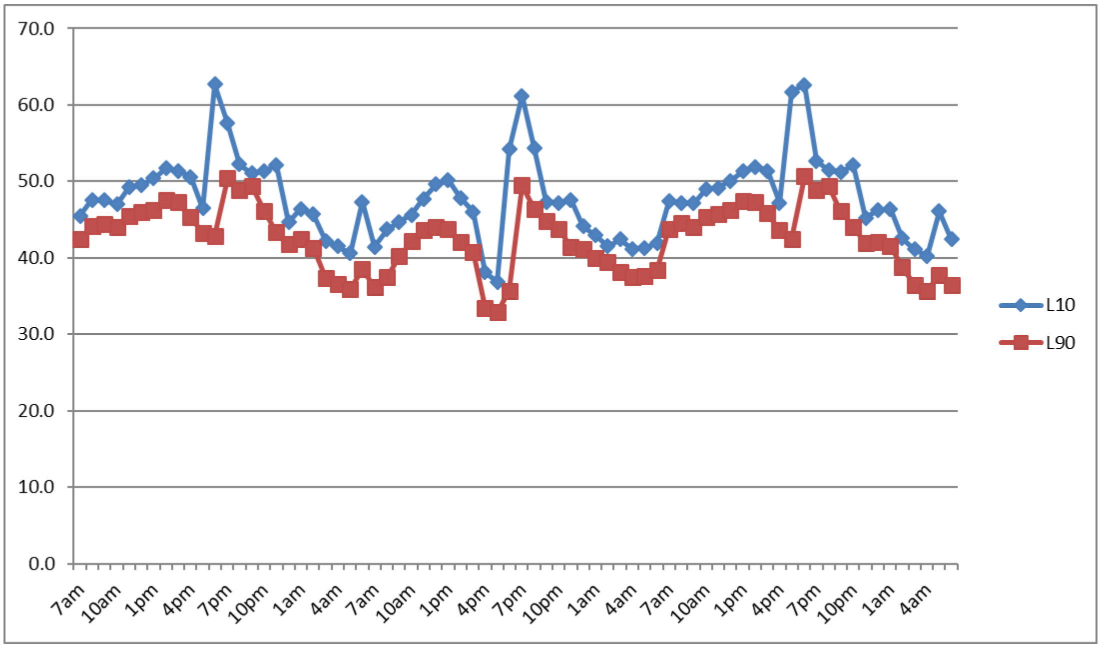
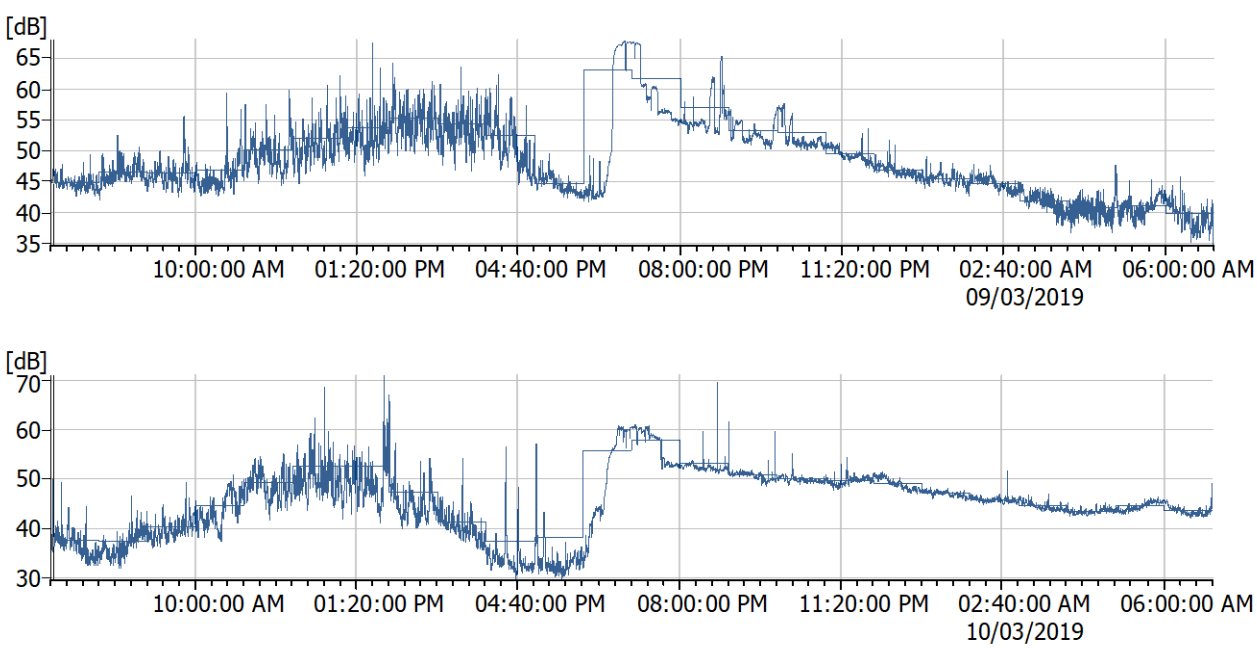


Figure 6-47 L10 and L90 for Station 3

STATION 4

During the 72-hour period, noise levels at this station ranged from a low (Lmin) of 30.1 dBA to a high (Lmax) of 78.2 dBA. Average noise level for this period was 51.8 L_{Aeq} (72h). The fluctuation in noise levels over the 72-hour period is depicted in Figure 6-48.



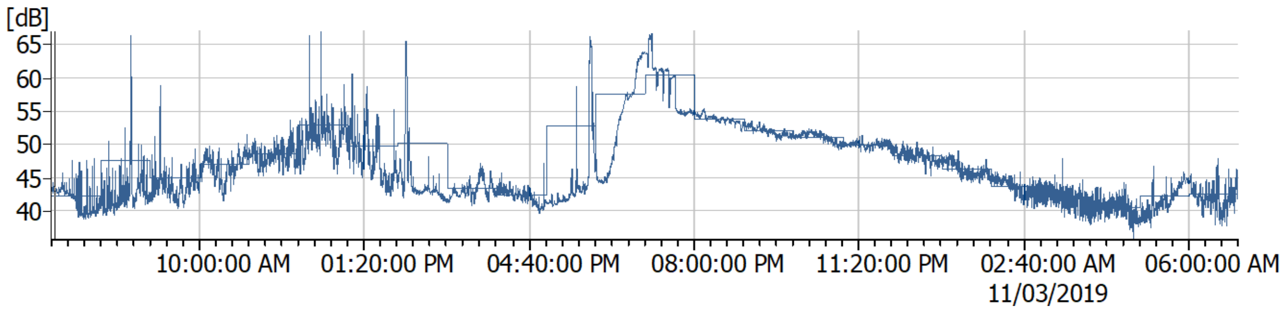
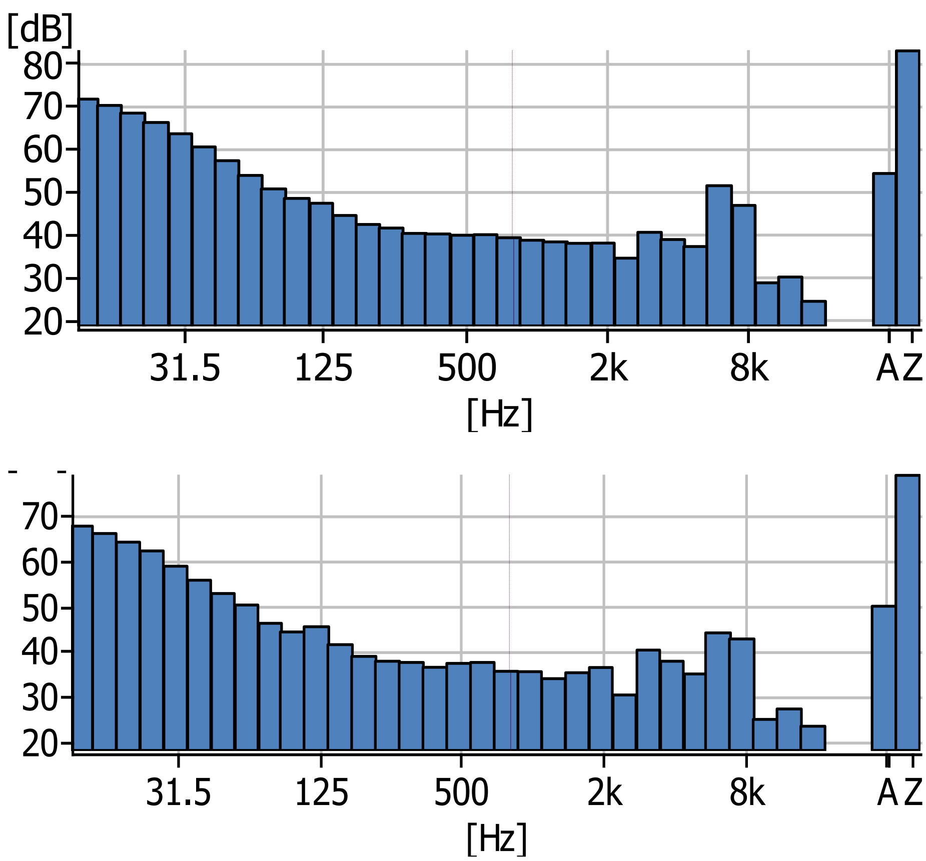


Figure 6-48 Noise fluctuation (Leq) over 72 hours at Station 4 (top: March 8-9, middle: March 9-10, bottom: March 10-11)

OCTAVE BAND ANALYSIS AT STATION 4

The noise at this station during the 72-hour period was in the low frequency band with a dominant geometric mean frequency of 12.5 Hz. (octave frequency range is 11 - 14 Hz) (Figure 6-49).



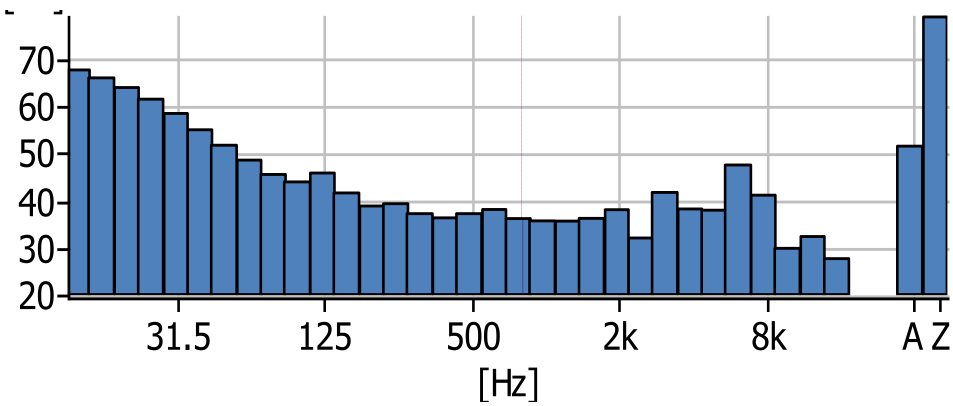


Figure 6-49 Octave band spectrum of noise at Station 4 (top: March 8-9, middle: March 9-10, bottom: March 10-11)

L10 AND L90

Figure 6-50 depicts the hourly L10 and L 90 statistics for this station over the noise assessment period. The data shows moderate fluctuations (L10 – L90) (≈38% of the time), large fluctuations (L10 – L90) (≈4% of the time) and no significant fluctuations (L10 – L90) (≈58% of the time), in the noise climate at this station. The overall L10 and L 90 at this station for the time assessed were 54.37 dBA and 39.68 dBA respectively.

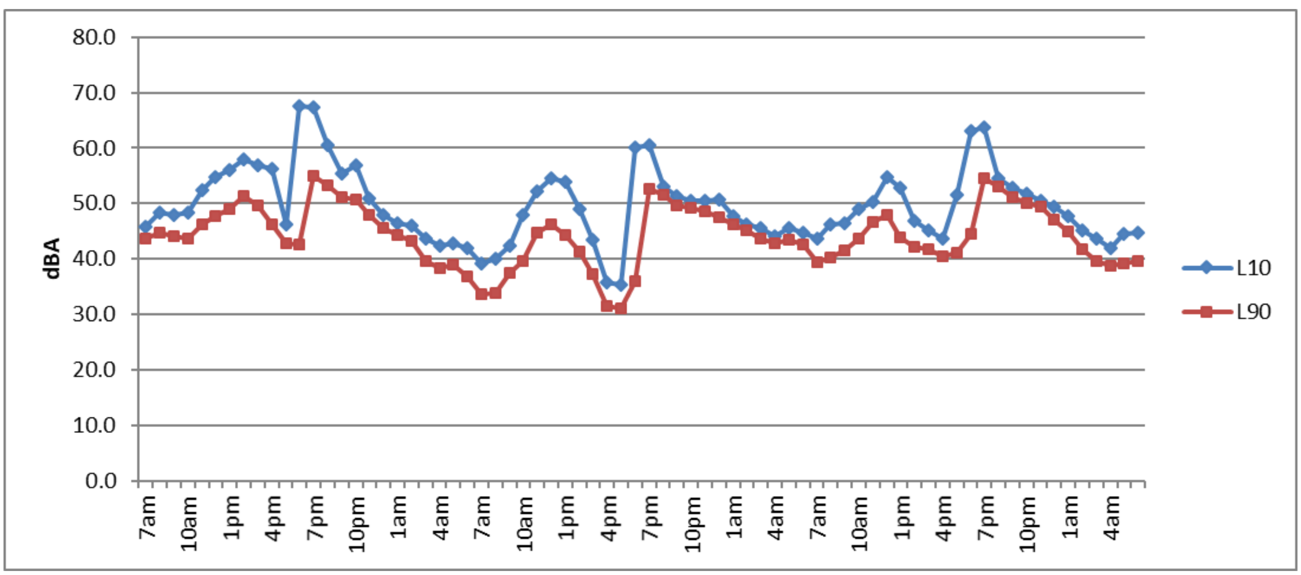


Figure 6-50 L10 and L90 for Station 4

STATION 5

During the 72-hour period, noise levels at this station ranged from a low (Lmin) of 33.7 dBA to a high (Lmax) of 76.6 dBA. Average noise level for this period was 50.4 L_{Aeq} (72h). The fluctuation in noise levels over the 72-hour period is depicted in Figure 6-51.

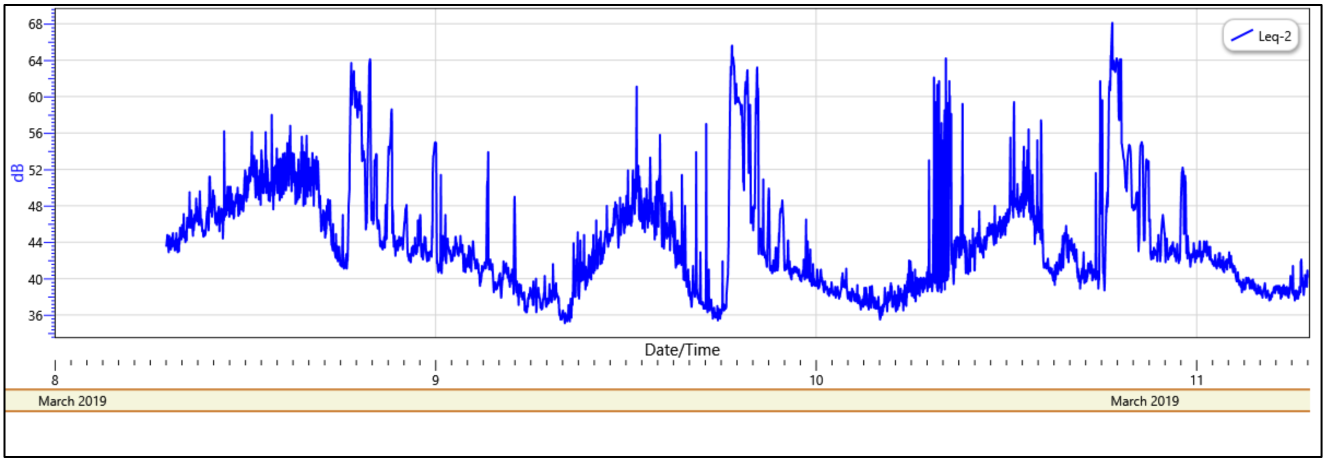


Figure 6-51 Noise fluctuation (Leq) over 72 hours at Station 5

OCTAVE BAND ANALYSIS AT STATION 5

The noise at this station during the 72-hour period was in the low frequency band centred around the geometric mean frequency of 12.5 Hz (octave frequency range is 11 - 14 Hz) (Figure 6-52).

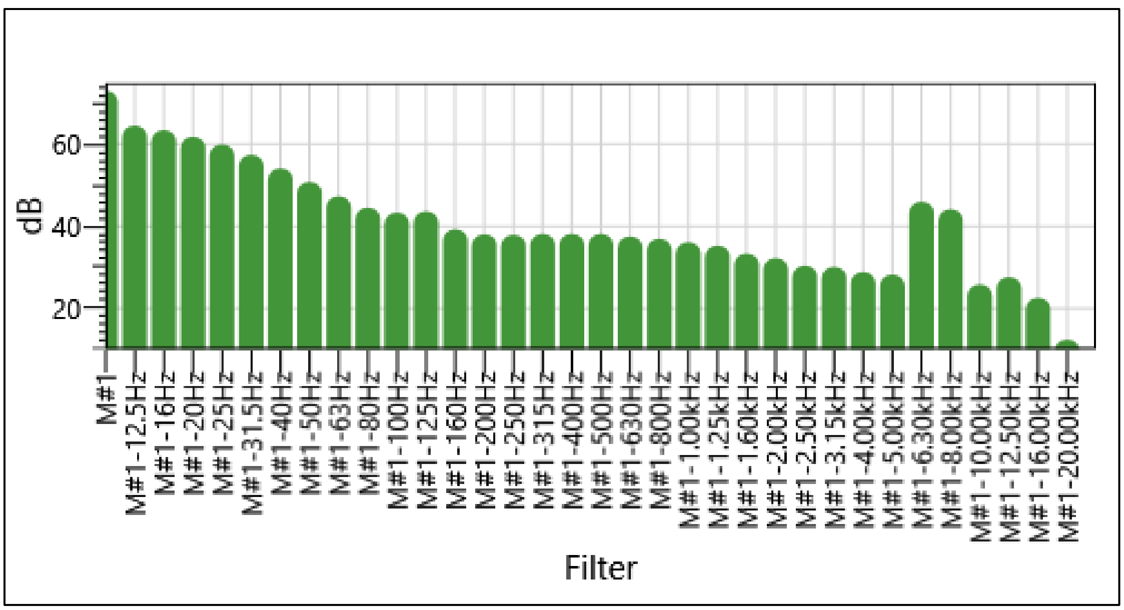


Figure 6-52 Octave band spectrum of noise at Station 5

L10 AND L90

Figure 6-53 depicts the hourly L10 and L 90 statistics for this station over the noise assessment period. The data shows moderate fluctuations (L10 – L90) (≈22% of the time), no significant fluctuations (L10 – L90) (≈71% of the time) and large fluctuations (L10 – L90) (≈7% of the time) in the noise climate at this station. The overall L10 and L 90 at this station for the time assessed were 52.1 dBA and 37.6 dBA respectively.

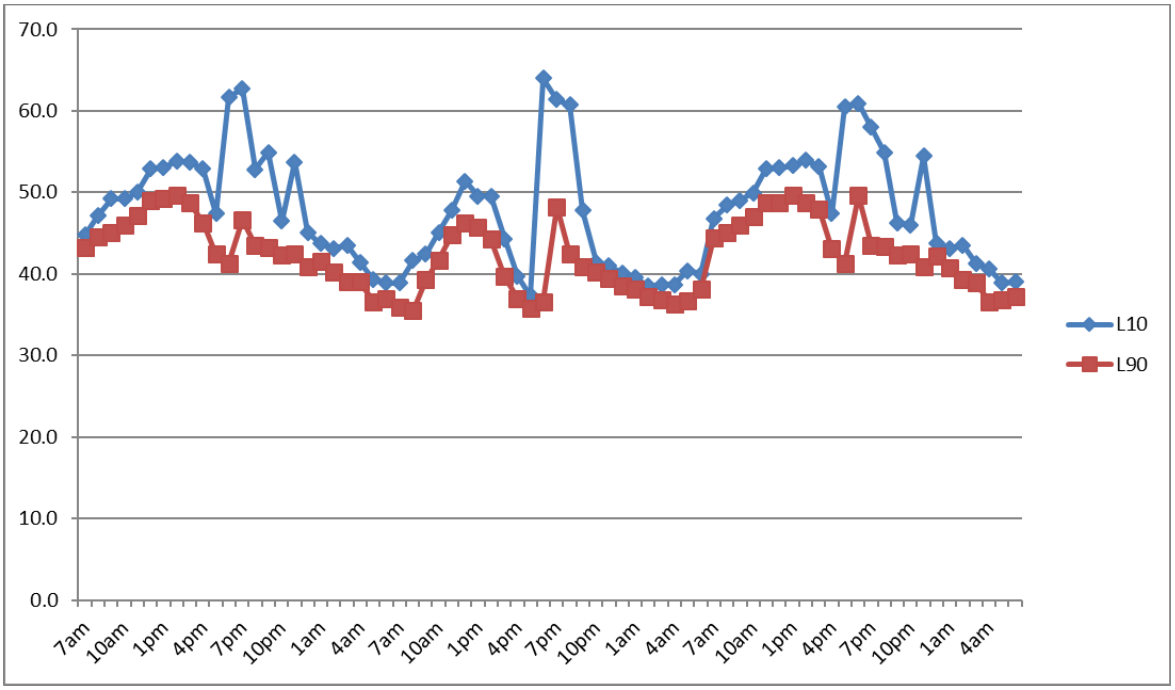


Figure 6-53 L10 and L90 for Station 5

STATION 6

During the 72-hour period, noise levels at this station ranged from a low (Lmin) of 29.9 dBA to a high (Lmax) of 88.2 dBA. Average noise level for this period was 61.3 L_{Aeq} (72h). The fluctuation in noise levels over the 72-hour period is depicted in Figure 6-54.

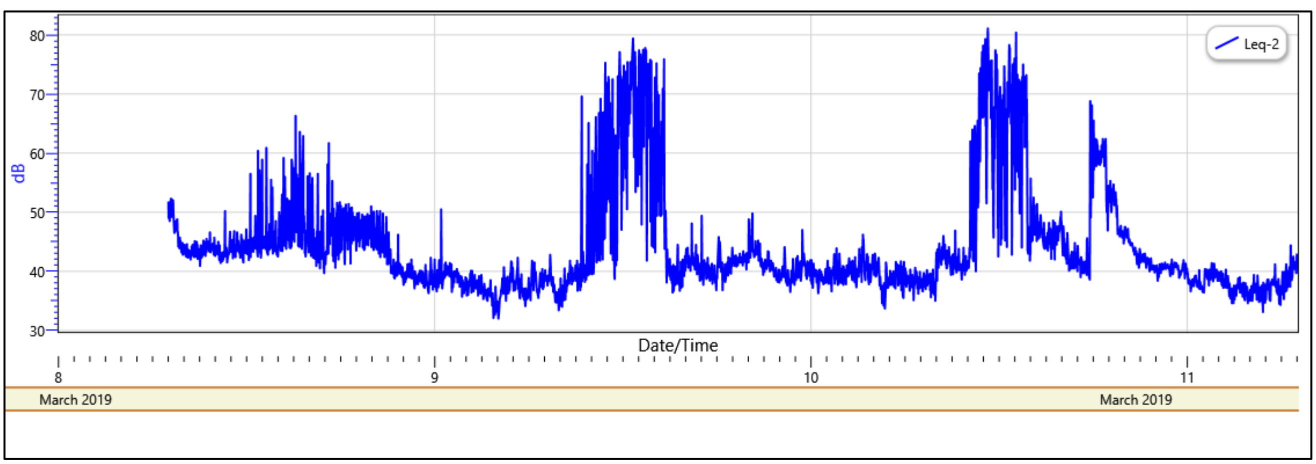


Figure 6-54 Noise fluctuation (Leq) over 72 hours at Station 6

OCTAVE BAND ANALYSIS AT STATION 6

The noise at this station during the 72-hour period was in the low frequency band centred around the geometric mean frequency of 25 Hz (octave frequency range is 22 - 28 Hz) (Figure 6-55).

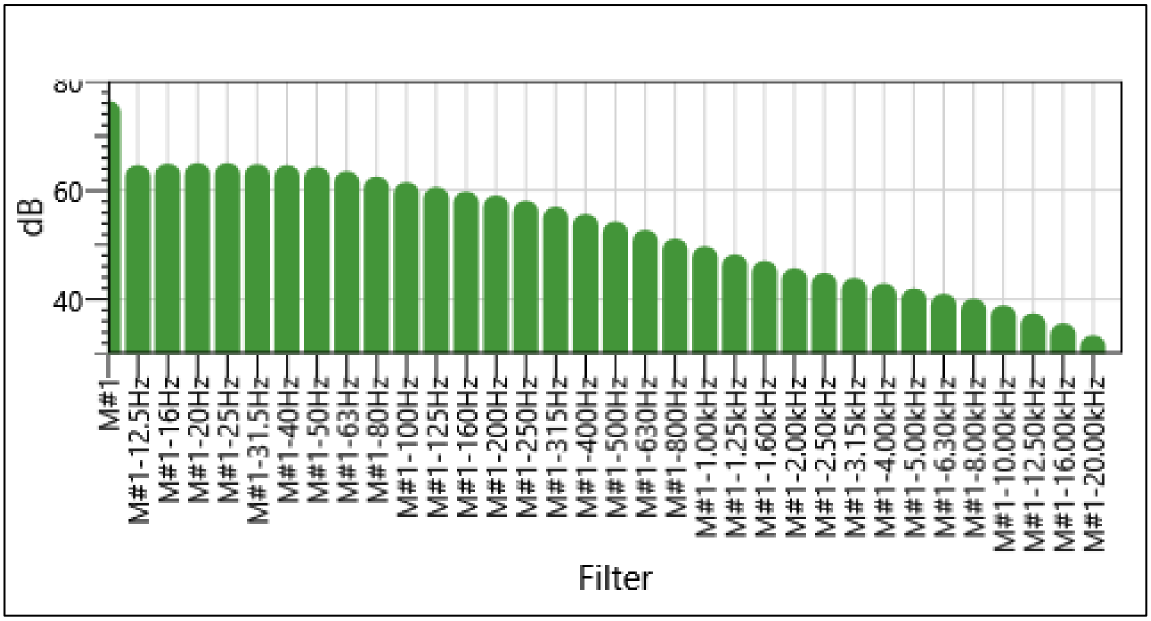


Figure 6-55 Octave band spectrum of noise at Station 6

L10 AND L90

Figure 6-56 depicts the hourly L10 and L 90 statistics for this station over the noise assessment period. The data shows moderate fluctuations (L10 – L90) (≈28% of the time), no significant fluctuations (L10 – L90) (≈65% of the time) and large fluctuations (L10 – L90) (≈7% of the time) in the noise climate at this station. The overall L10 and L90 at this station for the time assessed were 50.6 dBA and 37.4 dBA respectively.

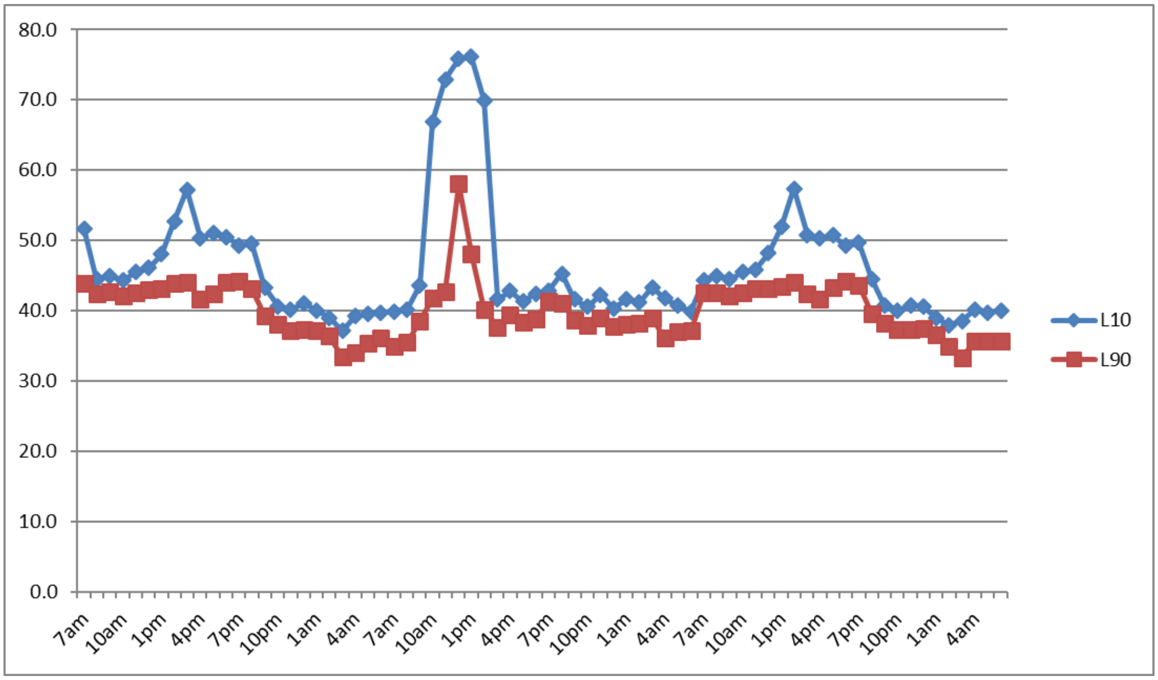


Figure 6-56 L10 and L90 for Station 6

STATION 7

During the 72-hour period, noise levels at this station ranged from a low (Lmin) of 28.8 dBA to a high (Lmax) of 67.5 dBA. Average noise level for this period was 48.1 L_{Aeq} (72h). The fluctuation in noise levels over the 72-hour period is depicted in Figure 6-57.

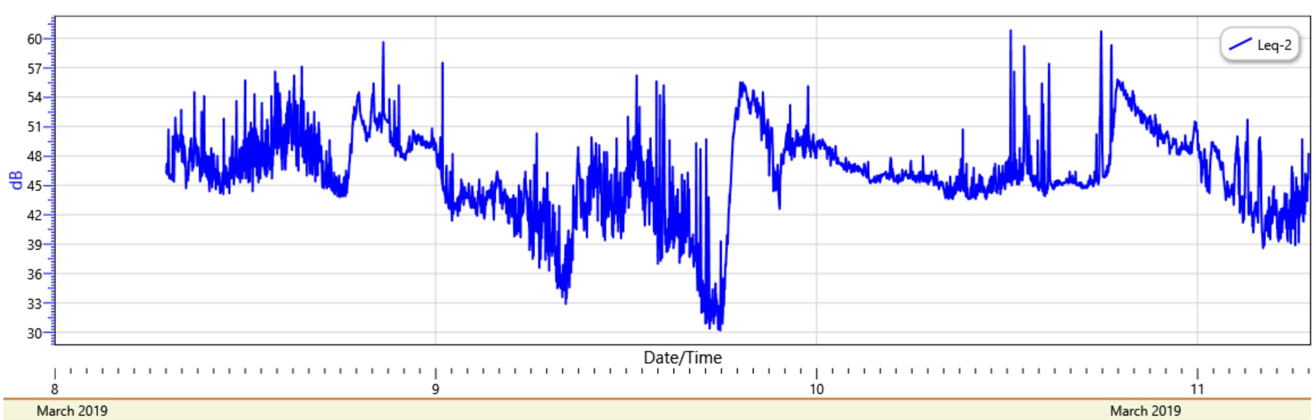


Figure 6-57 Noise fluctuation (Leq) over 72 hours at Station 7

OCTAVE BAND ANALYSIS AT STATION 7

The noise at this station during the 72-hour period was in the low frequency band centred around the geometric mean frequency of 12.5 Hz (octave frequency range is 11 - 14 Hz) (Figure 6-58).

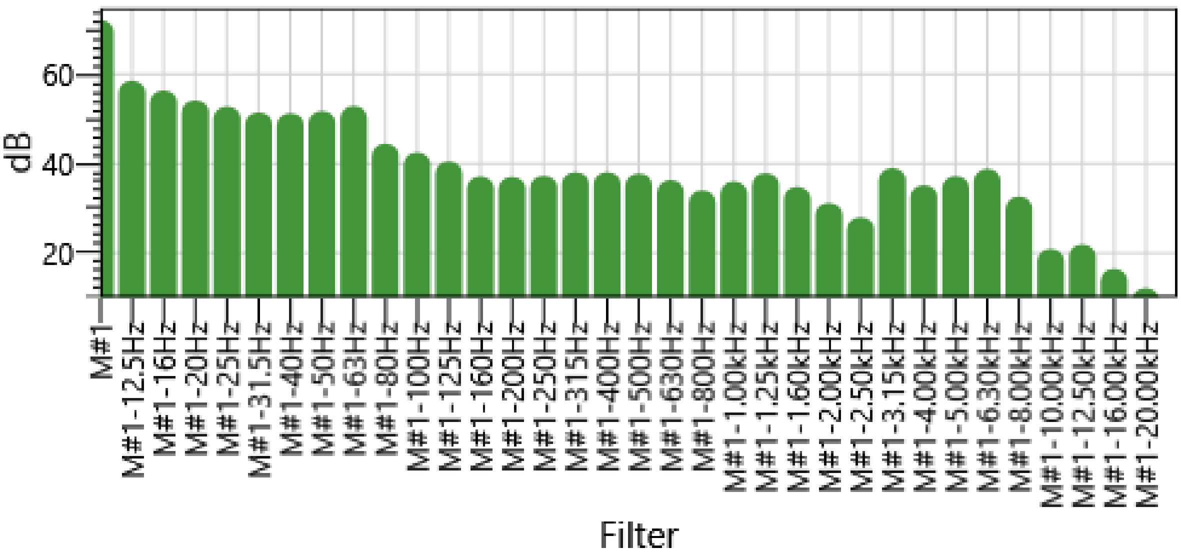


Figure 6-58 Octave band spectrum of noise at Station 7

L10 AND L90

Figure 6-59 depicts the hourly L10 and L 90 statistics for this station over the noise assessment period. The data shows moderate fluctuations (L10 – L90) (≈33% of the time), large fluctuations (L10 – L90) (≈1% of the time) and no significant fluctuations (L10 – L90) (≈66% of the time) in the noise climate at this station. The overall L10 and L 90 at this station for the time assessed were 51.3 dBA and 40.0 dBA respectively.

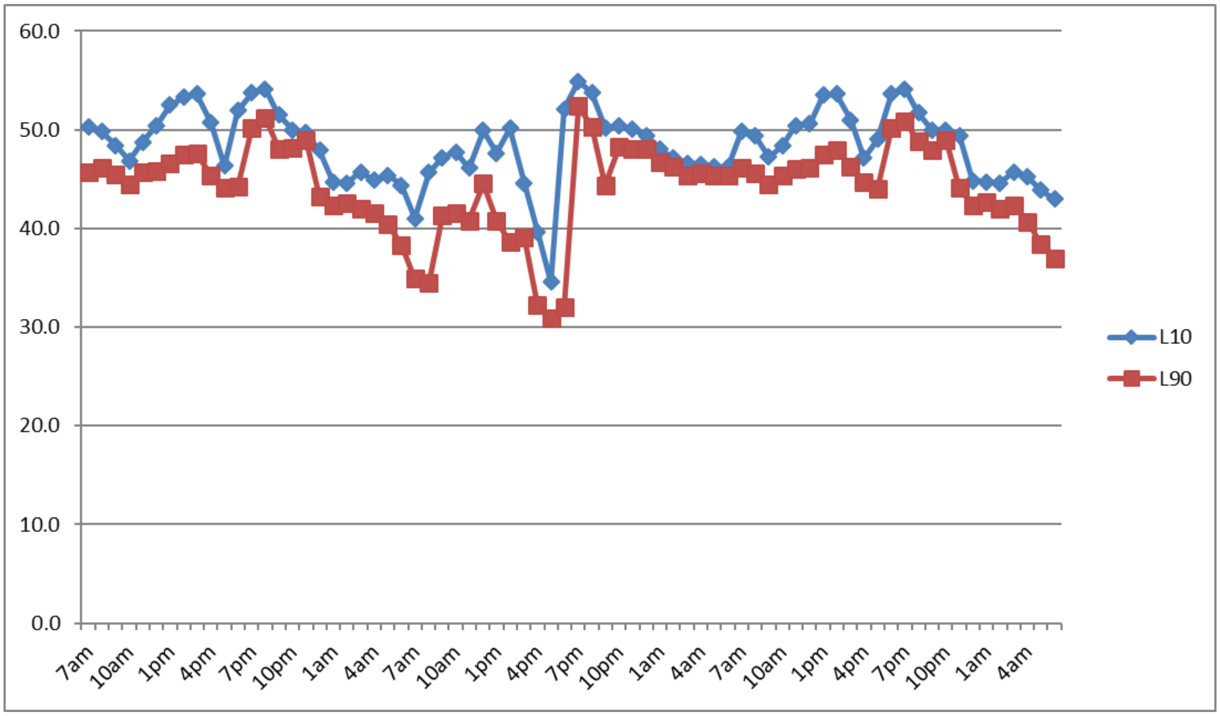


Figure 6-59 L10 and L90 for Station 7

Comparisons of Ambient Noise Levels with NRCA Daytime and Night-Time Guidelines

Comparison of the ambient noise levels in the study area with the Natural Resources and Conservation Agency (NRCA) Standards are shown in Table 6-16. During the daytime, noise levels at all Stations except Station 1 (56.7 dBA) were compliant with respective NRCA daytime standards. During the night-time, noise levels at all Stations were compliant with respective NRCA night-time standards.

Table 6-16 Comparison of daytime and night-time noise levels at the stations with the NRCA guidelines

Stn.#	Zone	7 am. - 10 pm (dBA)	NRCA Standard (dBA)	10 pm. - 7 am (dBA)	NRCA Standard (dBA)
1	Residential	56.7	*55*	48.9	*50*
2	Commercial	55.1	*65*	50.1	*60*
3	Commercial	49.7	*65*	44.0	*60*
4	Commercial	54.7	*65*	48.0	*60*
5	Commercial	52.2	*65*	42.0	*60*
6	Commercial	63.4	*65*	39.1	*60*
7	Commercial	48.8	*65*	46.7	*60*

NB. Numbers in red are non-compliant with the standard/guideline

6.1.14 Air Quality

6.1.14.1 Definitions

Coarse particles are airborne pollutants that fall between 2.5 and 10 micrometres in diameter. Fine particle are airborne pollutants that fall below 2.5 micrometres in diameter. Sources of coarse particles include crushing or grinding operations and dust stirred up by vehicles traveling on roads. Sources of fine particles include all types of combustion, including motor vehicles, power plants, residential wood burning, forest fires, agricultural burning, and some industrial processes.

6.1.14.2 Methodology

PM10 and PM2.5 particulate sampling exercises were conducted at the seven (7) locations (where noise monitoring was conducted) for 24 hours each on three (3) separate sampling occasions using Airmetrics Minivol Tactical Air Samplers (Plate 6-7). The locations are listed in Table 6-14 and illustrated in Figure 6-38. The PM10 sampling exercise was conducted from 12:00am – 12:00am on March 8th – 9th, August 9th – 10th and August 14th – 15th, 2019 whilst the PM2.5 sampling exercises were conducted from 12:00am – 12:00am on November 12th – 13th, November 13th – 14th and November 19th – 20th, 2019.

Plate 6-7 Particulate meter setup on site

6.1.14.3 Results

PM10

The summarized results of the PM10 sampling run is shown in Table 6-17. All locations had particulate PM10 values compliant with the 24-hour NRCA standard of 150 μg/m³. Detailed PM10 results are shown in Table 6-18

Table 6-17 Summarized PM 10 Results

STATION	AVERAGE PM10 RESULT (μg/m³)	RANGE (μg/m³)	NRCA STD. (μg/m³)
STN 1	**19.44**	10.83 – 28.06	150
STN 2	**30.05**	13.06 – 44.17	150
STN 3	**20.19**	10.56 – 29.86	150
STN 4	**21.41**	14.51 – 30.42	150
STN 5	**20.00**	11.39 – 29.31	150
STN 6	**18.98**	10.42 – 27.78	150
STN 7	**22.59**	14.31 – 35.28	150

Values in red are non-compliant with NRCA standards

Table 6-18 Detailed PM10 Results

Sampling Date	STATION	Result [PM_{10}]/ugm^{-3}	NRCA PM10 Std [PM10]/ugm-3
March 8-9, 2019	STN 1	19.44	150
	STN 2	44.17	
	STN 3	20.14	
	STN 4	19.31	
	STN 5	19.31	
	STN 6	18.75	
	STN 7	18.19	
August 9-10, 2019	STN 1	10.83	150
	STN 2	13.06	
	STN 3	10.56	
	STN 4	14.51	
	STN 5	11.39	
	STN 6	10.42	
	STN 7	14.31	
August 14-15, 2019	STN 1	28.06	150
	STN 2	32.92	
	STN 3	29.86	
	STN 4	30.42	
	STN 5	29.31	
	STN 6	27.78	
	STN 7	35.28	

Values in red are non-compliant with NRCA standards

PM2.5

The results of the PM2.5 sampling run is shown in Table 6-19. All locations had average particulate PM2.5 values compliant with the 24-hour USEPA PM2.5 standard of 35µg/m³. Detailed PM2.5 results are shown in Table 6-20.

Table 6-19 Summarized PM 2.5 Results

STATION	AVERAGE PM2.5 RESULT (µg/m³)	RANGE (µg/m³)	USEPA STD. (µg/m³)
STN 1	**15.47**	13.48 – 17.92	35
STN 2	**18.80**	15.42 – 24.58	35
STN 3	**10.42**	5.56 – 17.36	35
STN 4	**14.92**	9.72 – 18.10	35
STN 5	**11.02**	6.81 – 17.78	35
STN 6	**11.48**	1.11 – 19.72	35
STN 7	**19.12**	13.75 – 22.64	35

Values in red are non-compliant with NRCA standards

Table 6-20 Detailed PM2.5 Results

Sampling Date	STATION	Result [PM2.5]/ugm^{-3}	USEPA PM2.5 Std [PM2.5]/ugm-3
November 12-13, 2019	STN 1	13.48	35
	STN 2	16.39	
	STN 3	8.33	
	STN 4	9.72	
	STN 5	6.81	
	STN 6	1.11	
	STN 7	13.75	
November 13-14, 2019	STN 1	17.92	35
	STN 2	24.58	
	STN 3	5.56	
	STN 4	18.10	
	STN 5	8.47	
	STN 6	19.72	
	STN 7	20.97	
November 19-20, 2019	STN 1	15.00	35
	STN 2	15.42	
	STN 3	17.36	
	STN 4	16.94	
	STN 5	17.78	
	STN 6	13.61	
	STN 7	22.64	

Values in red are non-compliant with NRCA standards

6.1.15 Sources of Existing Pollution

The low-lying nature of the site makes it easy for runoff to pond in the forest and reduces the potential for landward flooding from the sea. Several drainage channels and areas of ponding exist within the mangrove forest. Water quality results (Section 6.1.11.2) in two areas within the mangrove forest show that there is a high level of faecal coliform and faecal *Enterococcus sp.* bacteria present. The source of these bacteria may be from residential communities east and southeast of the property boundary. Section 6.3.2.5 discusses potential groundwater contamination and observed soakaway pits in these residential communities.

6.2 BIOLOGICAL ENVIRONMENT

6.2.1 Negril Environment Protected Areas

The proposed project area falls within the several categories of management and protection; The Negril Environmental Protection Area (Negril EPA), Negril Marine Park (NMP) and the Western section of the site on the boundary of the Environmental Replenishment Zone (Negril ERZ) and the Green Island Fish Sanctuary shown in Figure 6-60 and Figure 6-61. NEPA created a terrestrial wetland conservation area as part of the development guidelines for the area in 2015. The Negril EPA was declared a protected area under the Natural Resources Conservation Authority Act in 1997, which includes a total of 406.7km^2 of coastal and marine ecosystems such as the Negril Great Morass, the island's second largest coastal wetland. The NMP was established 1998 and covers an area approximately 160 km^2. The ERZ is part of a five-year zoning plan (2017-2020) for the strict protection of marine nursery and breeding grounds. According to the World Bank. 2019. Mangroves Monitoring and Evaluation Manual-Jamaica Several mangrove stands had increases in size, such as the Negril Great Morass increasing approximately 42% from 1,815ha in 2005 to 2,584ha in 2011, while others protected areas showed a decline. The area is currently used by game bird hunters as shown in Plate 6-68, and perhaps crocodiles as highlighted during conversations with residents. Fishermen also use section of the property and surrounding areas. Game bird hunting in this area is of particular concern because of the presence of Whistling ducks (in particular) and other local and migratory ducks on the property.

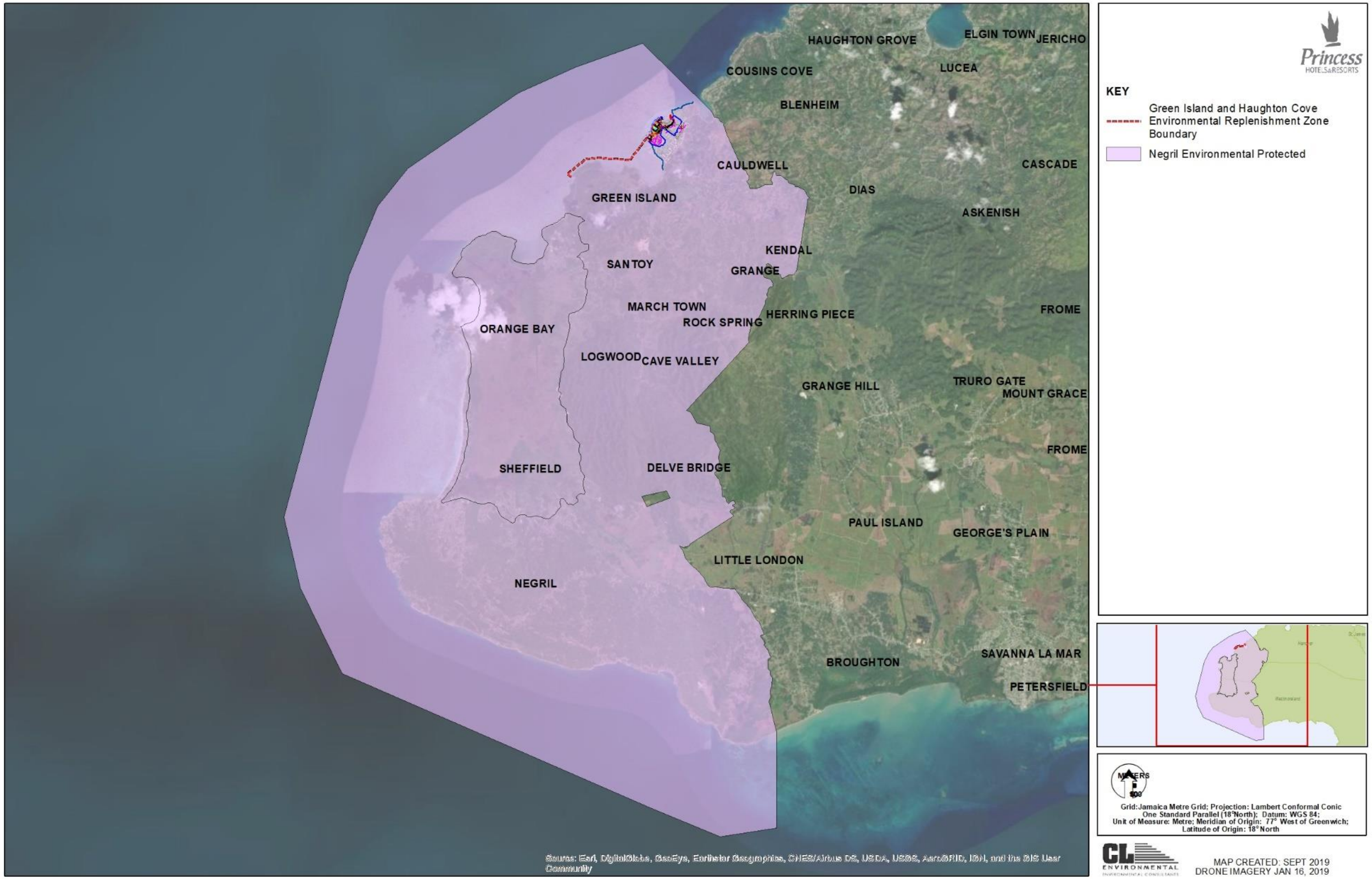


Figure 6-60 Negril Protected Areas

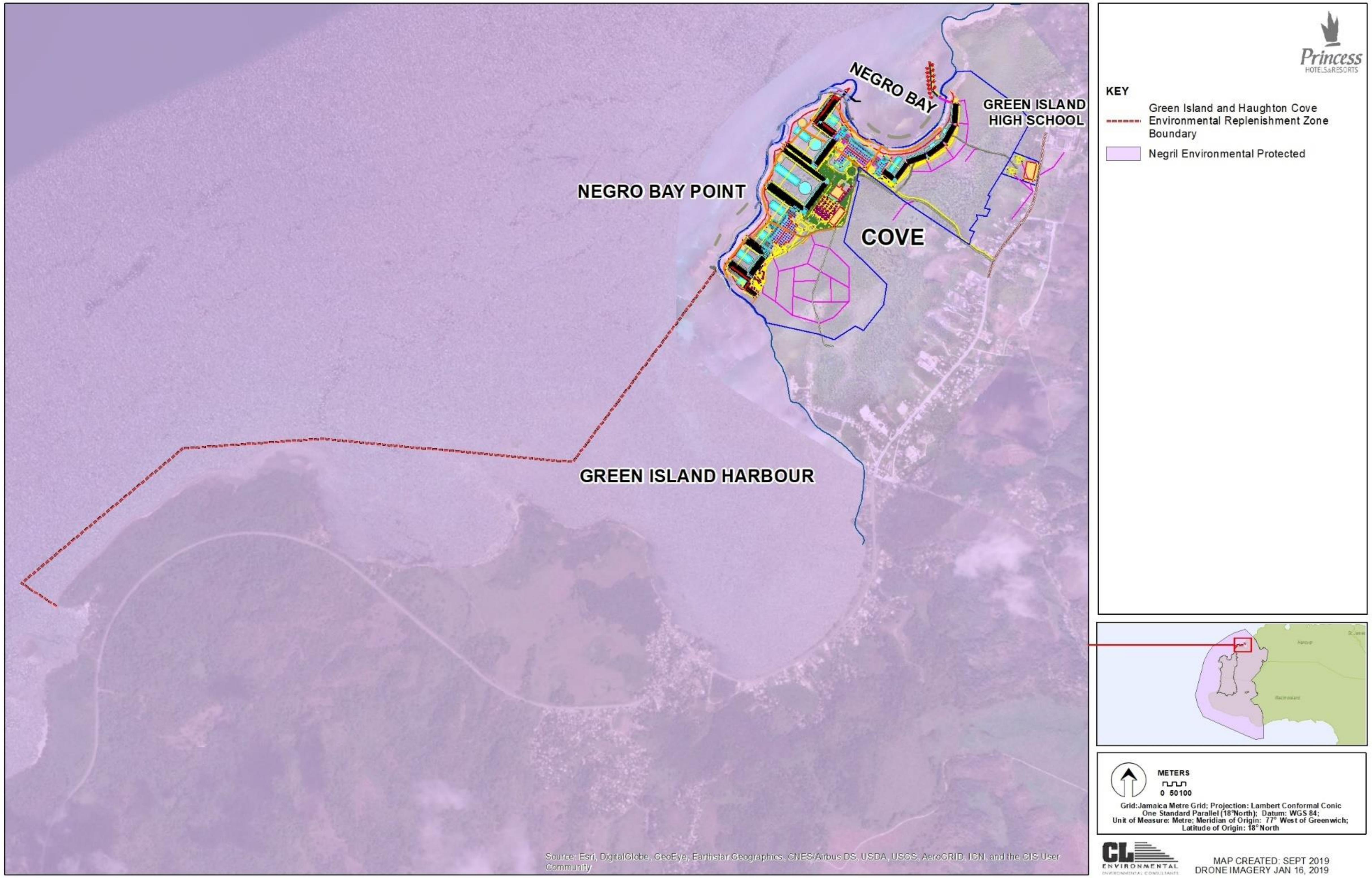


Figure 6-61 Negril Protected Area and Environmental Replenishment Zone

6.2.1.1 Industry Cove Rapid Ecological Assessment Summary (NEPA 2015)

The following is a summary of the Industry Cove report (NEPA , 2015), and is outlined below. It should be noted that the report refers to the proposed project area as Industry Cove, however the area itself is known as Cove, bordered by Industry Cove toward the north-eastern section of the property. The report makes several recommendations for development and conservation. According to the report, the site is predominantly wetland vegetation (primarily mature Mangrove trees, 10-15m high), with shrub in disturbed areas surrounded by a mixture of residential and commercial activities along the main road. The property is bordered by a raised reef system. The physiography of the area can be described as a swamp underlined by white limestone at an elevation ranging between 1.5-15 m above sea level with slopes ranging from 0-50.

The forest structure of the mangrove and wetland area was found to be dominated by mature black (*Avicennia germinans*) and red mangroves (*Rhizophora mangle*). The mean diameter at breast height (DBH) ranged from a low of 4.2 cm to a high of 22.6 cm. The average height ranged from a low of 3.5 m to a high of 10 m. An average of 30 saplings were encountered for each $4m^2$ area assessed.

The tree heights and diameters indicated that this was a mature and established forest, achieved over very long time periods. The resilience of the forest is also bolstered by its ability to regenerate following catastrophic events and the high number of saplings observed during the assessment is indicative of the ability to recover from natural stressors.

There were high levels of biological diversity, indicative of the ecological importance of the area. The report indicates over 100 species of plants, of which four are endemic and two of which are only identified from the Negril area. Avifaunal assessments determined that the site is an important roosting and foraging area for a number of local and migrant bird species. Thirty-six (36) species of birds were observed including game birds and eight endemic species. The West Indian Whistling Duck (*Dendrocygna arborea*), and the migrant Yellow-bellied Sapsucker were observed.

The site was found to be periodically affected by climatic events such as tropical storms, hurricane and forest fires cause by lightning strikes (along with other natural stresses). Anthropogenic stresses found include; land clearing activities, roadway construction, and charcoal burning. The most significant impacts to the mangrove forest have been from land clearing activities and road construction. This has led to a noticeable change in the vegetative cover in the northern sections of the property and also in the fragmentation of approximately 4.7 Ha of mangrove forest in the north-eastern region.

6.2.1.2 Historical Biological and Site Modification

The beaches nearby and along the proposed project area were historically known for nesting and foraging turtles and manatees while the wetland areas are known for crocodiles, whistling ducks, and game birds associated with the significant black mangrove forest and wetland area. Other endemic flora and fauna species have been outlined above in previous studies and anecdotal information.

The beach and nearshore, in particular in Negro Bay, has been modified at various stages over time (Figure 6-62), including beach nourishment/reclamation rock and tyre groynes as well as the removal of red and black mangroves, cutting of roads and other anthropogenic stresses highlighted in the (NEPA , 2015) report. .

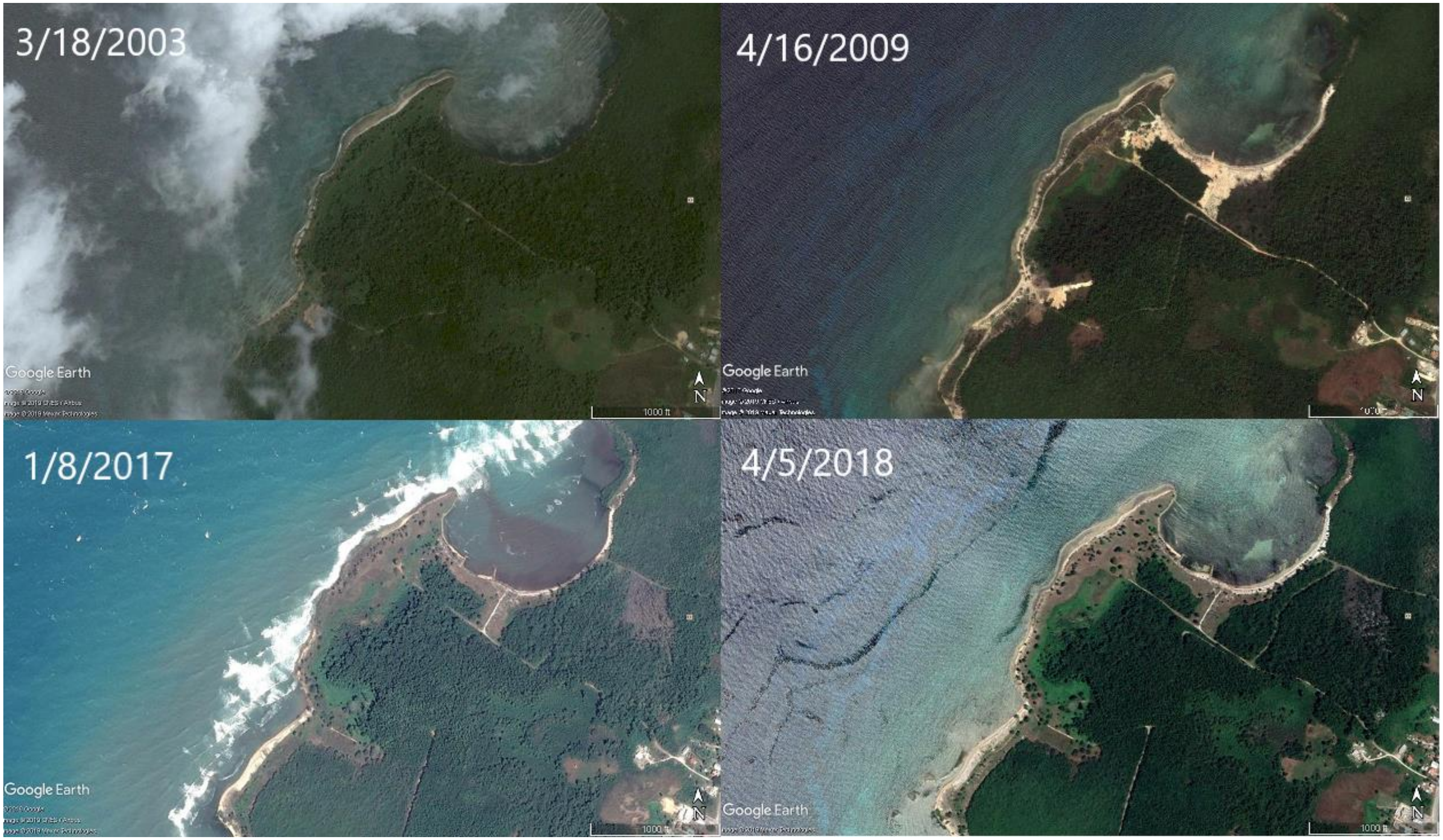


Figure 6-62 Modification of the proposed property between 2003 - 2018

6.2.2 Coastal and Benthic Environment

The proposed project footprint includes some coastal modification along the entire property shoreline. This length of coastline has several different substrate types, varying seagrass bed density and diversity, coral, pavement, rocky shores and intertidal communities. The Negro Bay lagoon and beach areas are the main marine construction areas and areas with previous modifications. The beach along Negro Bay is regularly cleared of small amounts of marine debris, dead algae and seagrass. The bay has a main channel that enters near the western end of the red mangroves stand, which carries some sediment and run off from the surrounding communities. The western most section of the property is located at the tip of Green Island Harbour. The seagrass beds range from dense, *Thalassia* dominated beds to extremely sparse areas and areas dominated by macro algae. All three species of seagrass were found in the proposed project; *Thalassia testudinum, Syringodium filiforme,* and *Halodule wrightii*. The seagrass bed community is not uniformed, some areas appearing sparse with a short, discoloured blades or areas that lacked typical species such as hard coral species, invertebrates and fish. Some beds were dense with very long blades, epiphytes and macrofauna. Visibility along most of the nearshore in Negro Bay, Green Island Harbour and soft/silty areas was found to be moderate to significantly poor, while the rocky shore and pavement areas were usually clearer.

The proposed project area is associated with an extensive reef system, including a raised, fringing reef along Negro Bay, varying shallow pavement areas with patch reefs and Buttress with a varying relief, spur and groove formation. Thickets of the critically endangered *Acropora cervicornis* were found at several locations. At the time of the surveys the reefs were undergoing a massive bleaching event at all depths during the survey. Hard coral diseases were also common.

Green Island Harbour is the main fishing area, including a fishing beach and oyster farm, however areas near by the proposed project area are used for spearfishing, pot fishing, netting and non-motorized line fishing.

Several surveys were done in and around the proposed project area and are shown Figure 6-63. Nearshore areas were mapped, and species lists and photo inventories generated. Roving surveys were conducted, and general observations were made. Visibility in Negro Bay was usually poor, while other areas tended to be shallow with moderate wave action. Survey methods were modified if necessary.

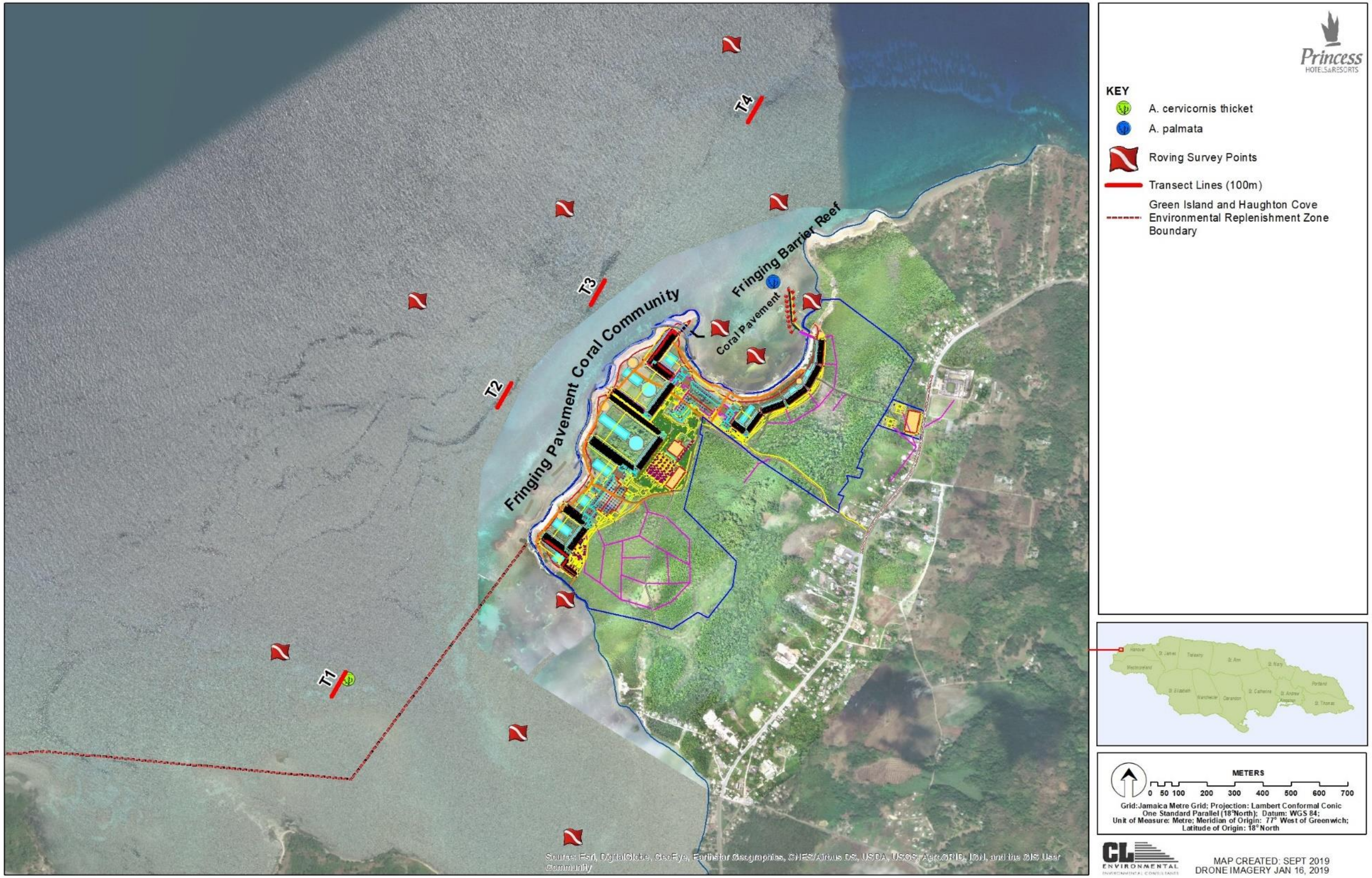


Figure 6-63 Survey Points and Transect Lines

6.2.2.1 Pavement Intertidal and Groyne Communities

The proposed project area has several distinct nearshore communities. There are small sandy areas between Green Island Harbour and Negro Bay. Negro Bay has the most extensive sandy beach and nearshore areas. Most of the nearshore along the project area consists of pavement along a low-lying rocky shore and fringing reef. Sections of Negro and Green Island Harbour had soft, silty and in some areas an anoxic muddy substrate. Pavement is the dominant substrate along project area. Seagrass density and distribution varied throughout the pavement areas, while some areas were covered in turf and macro algae. Urchins (mainly *Echinometra sp.*) and small Hard corals (*Porites divaricata* and *Siderastrea siderea*) were also observed in pavement areas. A list of coral species seen in the nearshore survey areas is shown in Table 6-21.

Table 6-21 Coral Species seen in Nearshore Roving surveys

Acropora palamta
Siderastrea siderea
Siderastrea radians
Favia fagum
Diploria clivosa
Diploria strigosa
Porites asteroides
Porites
Porites divaricata
Orbicella annularis
Solonastrea sp.
Millipora
Manicina areolata
Montastrea cavernosa

Intertidal areas were found on both natural (rocky shore) and artificial substrate (existing rocky shore and tyres of the groynes and seawall areas). The typical zonation and species composition were not seen on the rocks and tyres. This area had a sparse distribution of snails while the subsurface areas had a few hard corals and macro algae. The limestone rocky shore areas showed moderate zonation and colonization with several snail species, chitons and limpets but with a patchy distribution. The groyne areas act as Fish Aggregation Devices (FADs) and substrate for colonization, increasing the ecological volume. Examples are shown in Plate 6-8 - Plate 6-15.

Plate 6-8 Example of a pavement area along the nearshore

Plate 6-9 Massive and Encrusting coral colonies in pavement

Plate 6-10 Seagrass in pavement

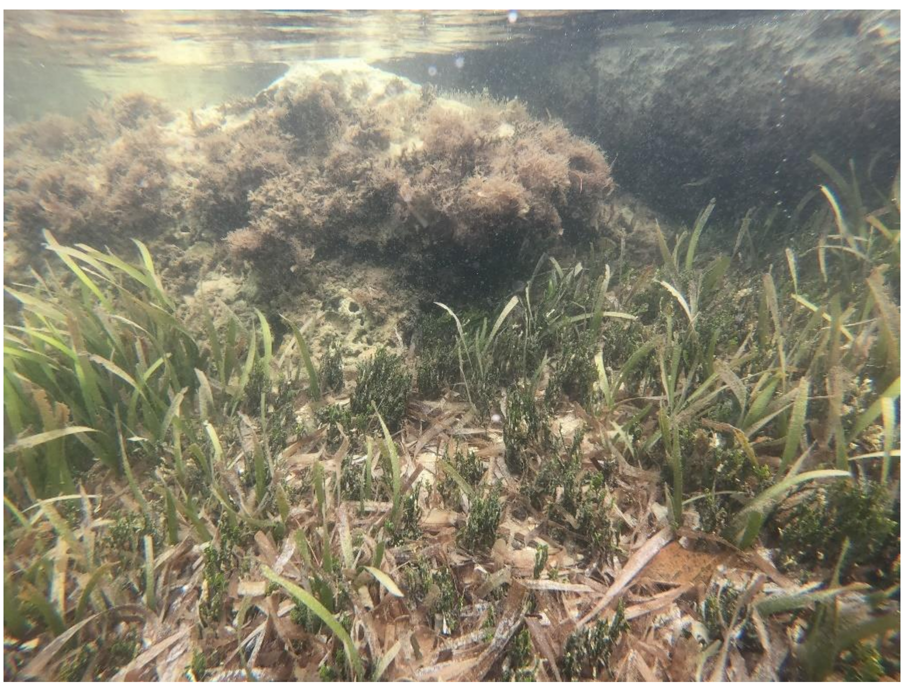


Plate 6-11 Groyne rocks in the seagrass bed

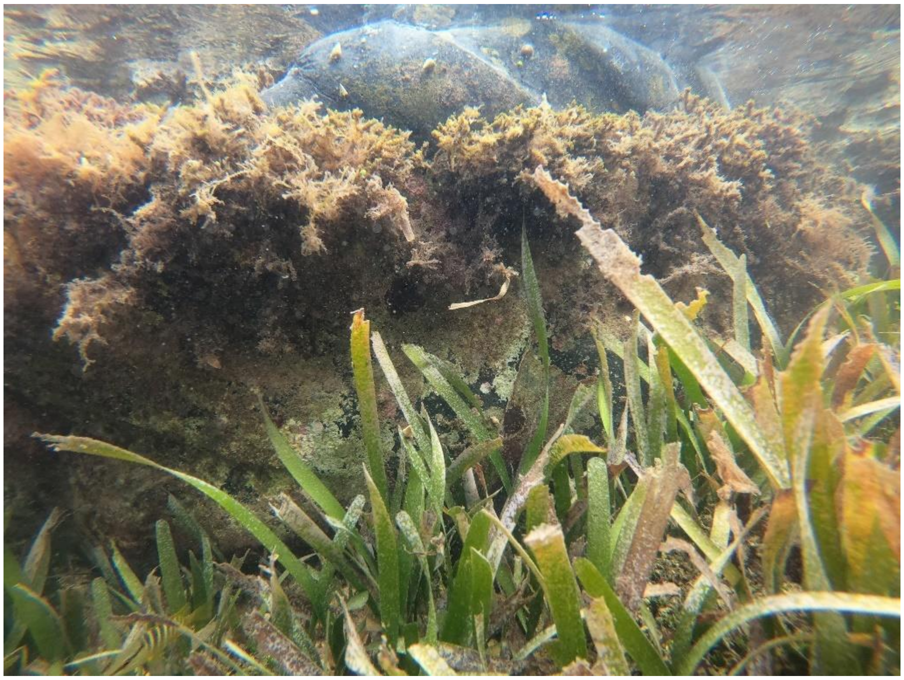


Plate 6-12 Tyre used in a section of the groyne

Plate 6-13 Fish utilizing the groyne area

Plate 6-14 Branching *Porites divaricata*, encrusting *Siderastrea siderea* colonies

Plate 6-15 Section of the groyne intertidal community

6.2.2.2 Seagrass Community

Description and Boundary Methodology

The seagrass beds and other distinct communities (*Halimeda* bed) within and nearby the proposed project footprint were mapped and surveyed using a Trimble Geo 7X GPS. The beds were mapped by walking along the boundaries where possible (visibility as well as varying seagrass density made identifying clear boundaries difficult in some areas). Point Analysis were conducted within a grid pattern along the nearshore with 1.5m graduated Polyvinyl chloride (PVC) poles. Data collected at each

probe point included; substrate composition (seagrass, sand, algae etc.), substrate type (pavement, mud, sand etc.) and general observations. Mapped areas are shown in Figure 6-64.

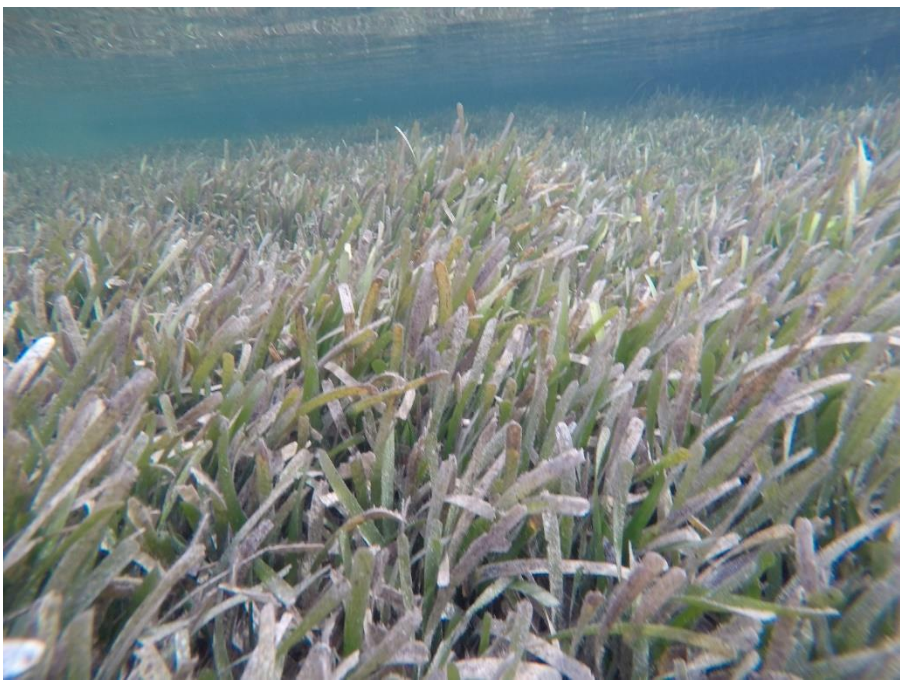


Plate 6-16 Section of a Dense *Thalassia* Bed

Plate 6-17 Patchy Distribution of *Thalassia* on pavement and rubble

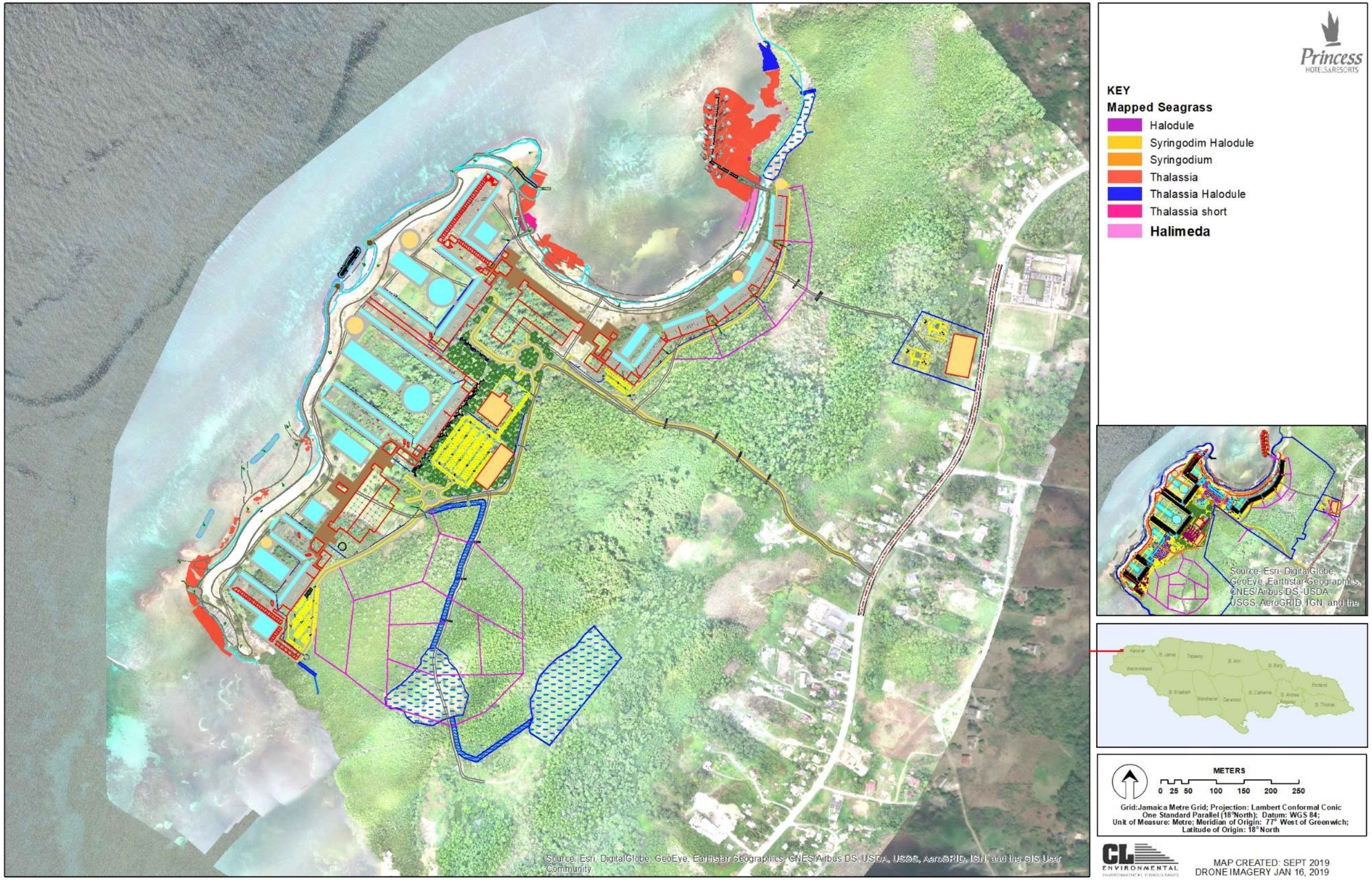


Figure 6-64 Total Mapped Seagrass and *Halimeda* Areas within proposed structure footprints

Results and Observations

The seagrass community within and around the proposed project area is dominated by *Thalassia testudinum*. Small *Syringodium filiforme* and *Halodule wrightii* and some mixed species beds were also observed in the area. The proposed project area extends from the East of Negro Bay extending West by Negro Bay Point to the tip of Green Island Harbour. Negro Bay has an extensive seagrass bed, composed mostly of *Thalassia,* with a mixed substrate consisting of sand, mud and pavement. (Plate 6-16). Negro Bay Point is dominated by a pavement substrate with a patchy distribution of seagrass, macroalgae, sand and encrusting species, such as hard and soft corals, sponges, urchins and other macro invertebrates. The area is dominated by *Thalassia* with small *Halodule* and *Syringodium beds*. These are very shallow areas and can have significantly reduced visibility. (Plate 6-17) The seagrass communities at the Western end of the project site merge into Green Island Harbour , where they move from a predominately pavement substrate with patchy seagrass distribution to a predominately sand and mud area with dense *Thalassia* beds.

Pavement can be described as a low-relief hard surface with little or no fine-scale rugosity that is covered with algae, hard coral, gorgonians, or other sessile invertebrates and a thin sand veneer. The coral community is dominated by small encrusting colonies, found mainly in pavement and surface areas.

Seagrass Distribution Methodology

A total of eight (8), 0.25m^2 quadrats, divided into 10cm x 10cm grids, were placed randomly within the seagrass beds. Three of the quadrats were used at Bed 1, and five of the quadrats were used between Bed 2. The locations of each random quadrat were marked using a Trimble Geo-7x geographical positioning system (GPS) (Table 6-22) and a map developed using ArcGIS software. Shoot density, percentage cover, leaf blade length, overall health and appearance and other organisms located within the seagrass beds were all recorded. Where possible, seagrass blades were assessed within each quadrat.

Shoot density was recorded within 5 random 10cmx10cm squares in each quadrat thrown. Percentage cover was recorded by counting the number of 10cmx10cm squares which contained seagrass. Leaf blade length was recorded by measuring 10 random lead blades within each quadrat thrown.

Table 6-22 Location of random quadrats for seagrass assessment

Quadrat #	LOCATION (JAD 2001)	
	NORTHINGS	EASTINGS
Q1A	695228.71	615575.52
Q2A	695244.14	615546.98
Q3A	695263.46	615531.11
Q1B	695495.98	615630.68
Q2B	695526.88	615667.15

Quadrat #	LOCATION (JAD 2001)	
	NORTHINGS	EASTINGS
Q3B	695552.93	615692.14
Q4B	695578.03	615714.40
Q5B	695595.94	615712.26

Results and Observations

Bed 1 consisted of predominantly muddy and sandy substrate. The seagrass beds had long blades and even distribution. Bed 2 consists mainly of pavement substrate leading to patchy and uneven seagrass beds.

The three quadrat samples taken at Bed 1, had an average shoot density of 31.7, an average percentage cover of 100% and an average mean blade length of 18.4cm. The five quadrat samples were taken along the Negro Bay Point coast, Bed 2. These had an average shoot density of 41, an average percentage cover of 84.8% and an average mean blade length of 11.02cm (Table 6-23).

Table 6-23 Table showing Shoot Density, Percentage Cover and Leaf Blade Length per quadrat

		SHOOT DENSITY	PERCENTAGE COVER MEASUREMENT				BLADE LENGTH (cm)										
Area	Quadrat #	Shoot Density	Number of Shoots in 25 squares	Number of Squares with Seagrass	Number of Squares in Quadrat	Percentage Cover (%)	1	2	3	4	5	6	7	8	9	10	Mean Blade Length (cm)
1	Q1A	22	110	25	25	100	25	30	19	21	17	20	12	15	14	8	18.1
	Q2A	29	145	25	25	100	25	12	17	19	11	25	24	16	24	13	18.6
	Q3A	44	220	25	25	100	12	15	21	11	15	18	17	25	29	23	18.6
Average		31.7	158.3	25	25	100	20.7	19	19	17	14.3	21	17.7	18.7	22.3	14.7	18.4
2	Q1B	31	155	20	25	80	10	8	6	4	10	15	9	7	6	11	8.6
	Q2B	35	175	25	25	100	12	19	14	10	9	16	17	13	11	14	13.5
	Q3B	53	265	21	25	84	7	11	15	9	8	7	15	19	10	6	10.7
	Q1B	30	150	17	25	68	10	11	16	9	5	12	8	17	16	10	11.4
	Q5B	56	280	23	25	92	11	8	9	12	10	21	13	10	7	8	10.9
Average		41	205	21.2	25	84.8	10	11.4	12	8.8	8.4	14.2	12.4	13.2	10	9.8	11.02

Seagrass Bed 1, located to the West of the project site, within Green Island Harbour had 100% cover and a mean blade length of 18.4cm. These beds are well established, with easy to grow in substrates, sand and mud, and large bulbs, shown by a smaler shoot density. Seagrass Bed 2, located along Negro Bay Coast had 84.8% cover and short blades 11.02cm. These beds are growing in a predominantly pavement substrate, which has lead to patchy distributions and small bulbs allowing for higher shoot density (Figure 6-65).

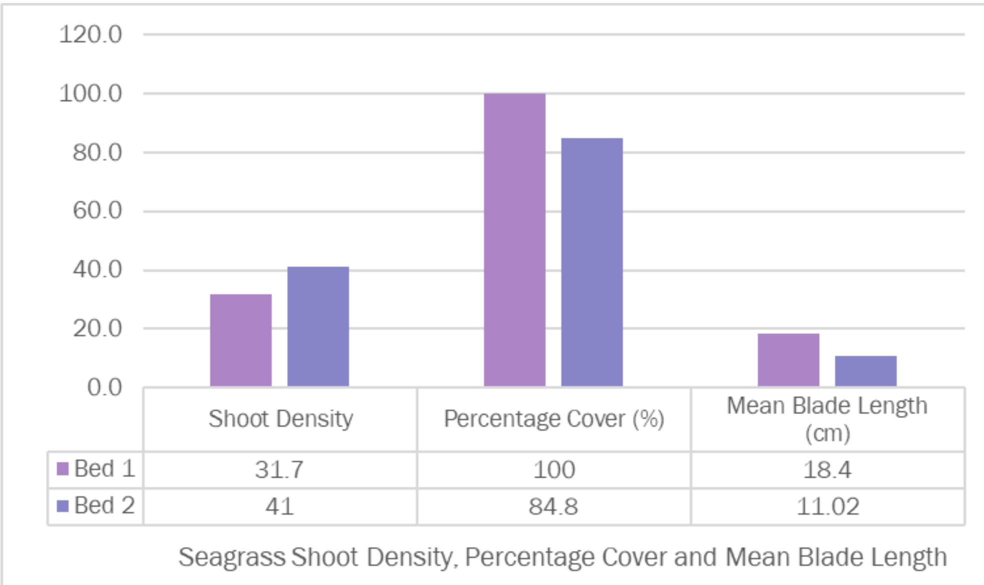


Figure 6-65 Seagrass Bed Comparison; Shoot Density, Percentage Cover and Mean Blade Length

FLORA AND FAUNA OBSERVED IN THE NEARSHORE ENVIRONMENT

Thalassia, Syringodium and Halodule seagrass was observed along the entire project area, with a majority of it being *Thalassia.* The project area was also host to various invertebrates and fish (Table 6-24). The Spotted and Ragged Seahare and *Cassiopeia* Jellyfish was mainly observed within Negro Bay, with the majority of *Cassiopeia* being observed to the Eastern end of the bay.

Table 6-24 Seagrass, Fish and Invertebrate Species Observed

Scientific Name	**Common Name**
FISH	
Abudefduf saxatilis	Sergeant Major
Microspathodon chrysurus	Yellowtail Damselfish
Lutjanus griseus	Mangrove Snapper
Chaetodon striatus	Butterfly Fish
Sphyraena	Great Barracuda
Mugilidae	Mullet
SEAGRASS	
Thalassia testudinum	Turtle grass

Scientific Name	Common Name
Syringodium filiforme	Manatee Grass
Halodule wrightii	Narrowleaf Seagrass
INVERTEBRATES	
Strombus gigas	Queen Conch
Aplysia dactylomela	Spotted Seahare
Bursatella leachii	Ragged Seahare
Holothuria mexicana	Donkey Dung Sea Cucumber
Cassiopeia sp.	Upside Down Jellyfish
Oreaster reticulatus	Starfish

Other Nearshore Areas

Negro Bay has a small defined *Halimeda* area within the proposed project footprint. *Halimeda* is a calcareous macroalgae and an important contributor to sand production and other ecological functions. This area was mapped and is illustrated in Figure 6-64. Other nearshore environments include silty muddy areas, most of which appear to be anoxic. Macroalgae and dead seagrass are concentrated and settle in and along sections of the bay, contributing to the poor visibility in this area.

6.2.2.3 Reef Community

Method

Eight (8) Permanent monitoring points were established, four of which were permanent transect line start point locations, along with 11 roving survey areas (Figure 6-63). A photo inventory, species list and general observations were recorded. Each transect line was 100 m long and run in a general E-W direction, parallel to the shoreline, maintaining a similar depth profile and avoiding large sand areas where possible. Photographs were taken every 5 meters using a 1 x 1 meter quadrat.

Results and Observations

Sections of the reef have a well-defined spur and groove formation (Plate 6-18 -Plate 6-19) between Negro Bay and Green Island Harbour west of Negro Bay while the east of the bay had a reef flat and patch reef topography. Deep sections of the reef had spur and groove formations with moderate relief. Reef health varied between survey areas; Shallow sites appeared to have had higher coral cover and less macro algae. The deeper sections of the reef were dominated by macro algae. Survey areas and transect lines are show in Figure 6-63 .

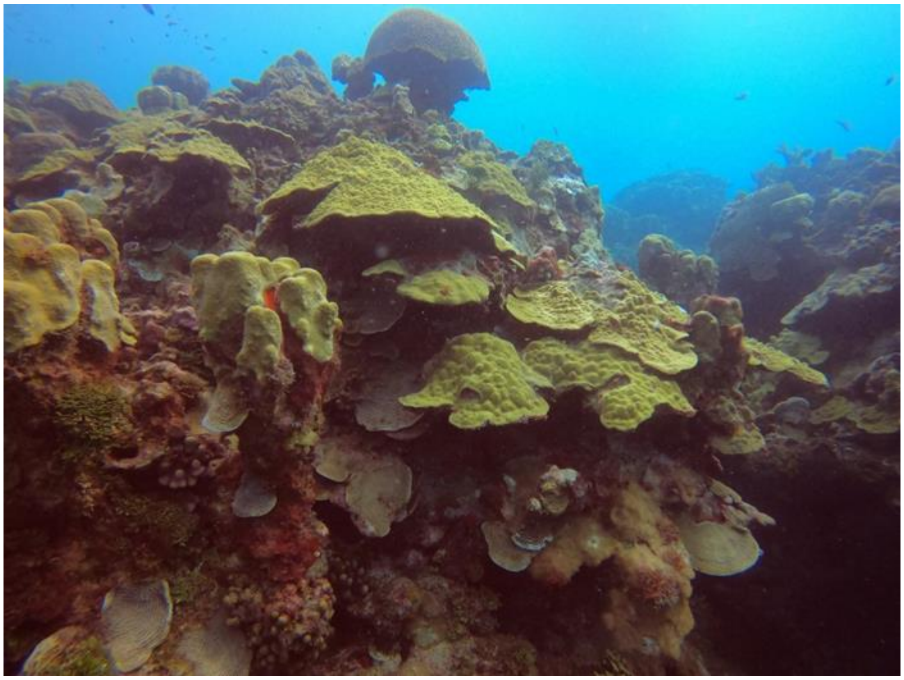


Plate 6-18 Large buttress with high coral cover

Plate 6-19 Permanent monitoring point on a small buttress

Fringing/Pavement Reef Areas were found along most of the nearshore outside Negro Bay and Green Island Harbour, shown in Plate 6-20 .

Plate 6-20 Pavement/ Reef flat Area along the nearshore

Deeper sections of the reef showed varying coral cover and in general, lower relief (Plate 6-21) .

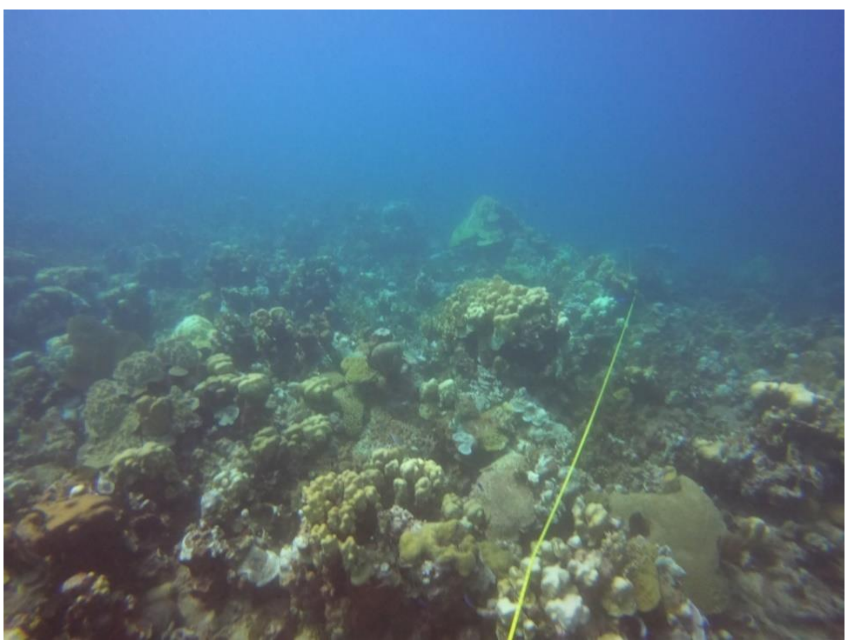


Plate 6-21 Low relief survey area

The reef community in the nearshore areas was dominated by macroalgae (68.5%), however coral cover was moderate (13.75%). A mass bleaching event and several diseased colonies were noted in the transect and the general area (Table 6-25). Examples of the bleaching event are shown in Plate 6-22 and Plate 6-23. Coral species diversity appeared to be low.

Table 6-25 Hard Coral and Macroalgal Cover

Substrate	% Cover
Macro Algae	68.53%
Hard Coral	13.75%
Bleaching	6.29%
Disease	0.93%

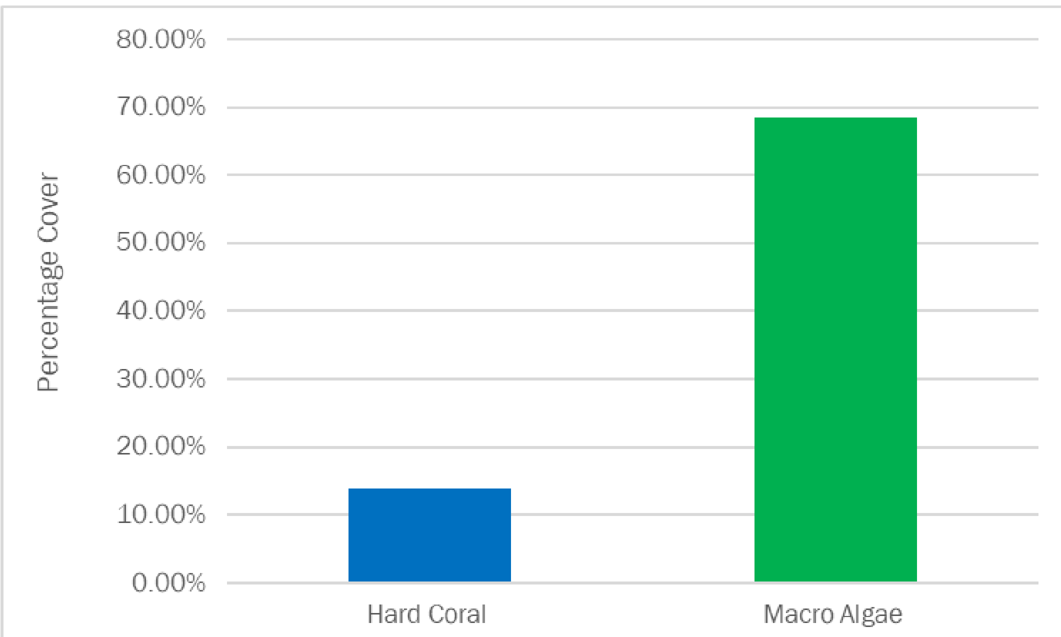


Figure 6-66 Hard Coral and Macro Algae Cover

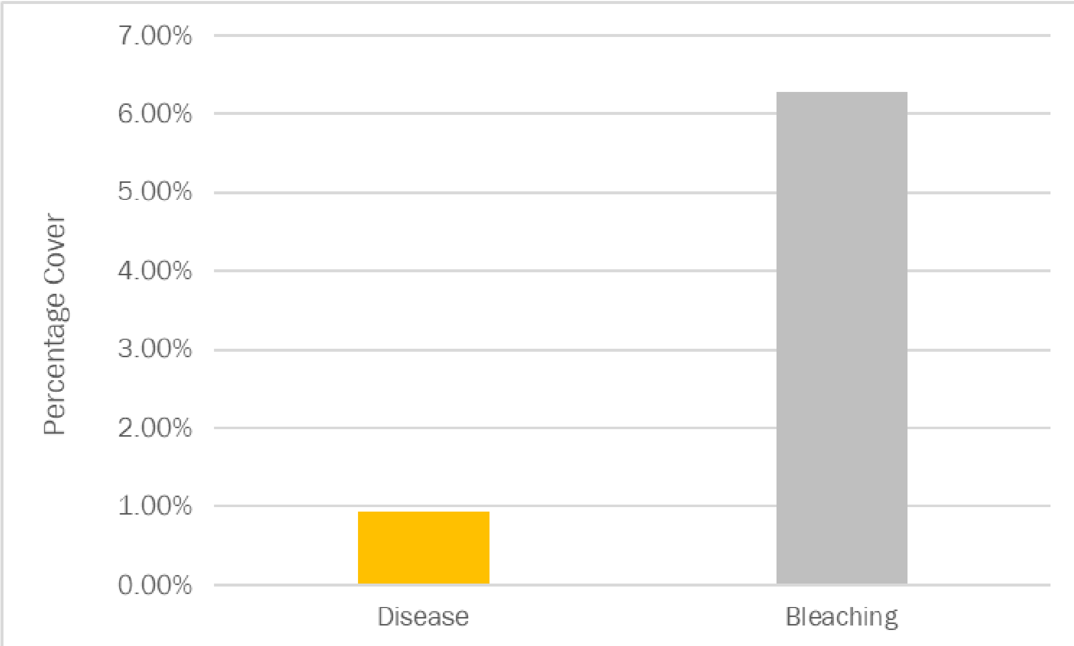


Figure 6-67 Disease and Bleaching Observed during Survey

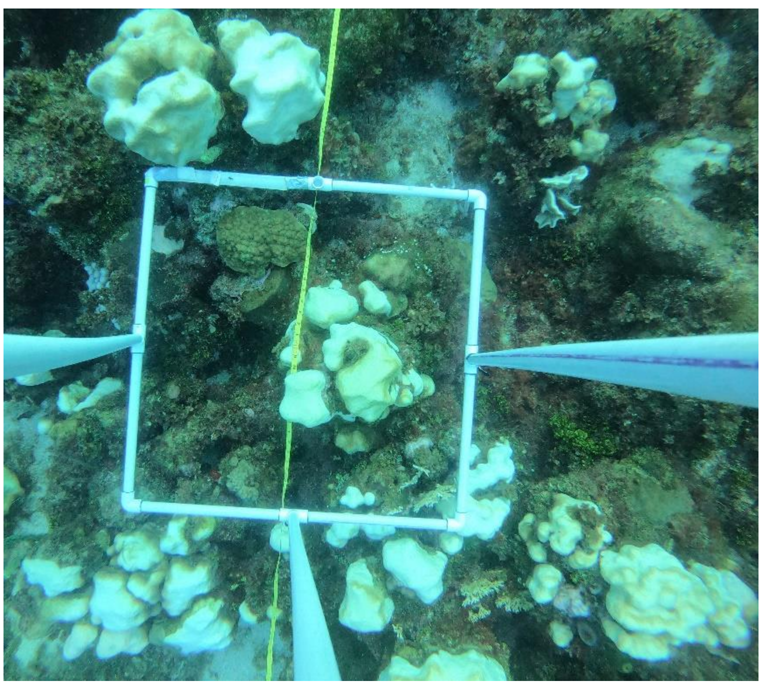


Plate 6-22 Coral bleaching observed along transect

Plate 6-23 Bleaching in the general area

Table 6-26 Coral Species in Transect Areas

Coral Species	% Cover
Agaricia sp.	3.26%
Madracis mirabilis	0.47%
Orbicella annularis	6.99%
Montastraea cavernosa	1.40%
Porites astreoides	1.17%
Siderastrea siderea	0.47%

General Observations

The reefs and in particular the hard coral community in and around the zone of influence of the proposed project, varied in structure, coral cover and overall health. The coral community was undergoing an extensive bleaching event during the surveys and several incidences of disease were observed. Bleaching was observed in most offshore survey areas and across coral species. The newly identified tissue loss disease, yellow blotch, black band and dark spot, were some of the diseases seen. Disease seemed to be highest in areas with higher coral cover. Some turbidity was seen at all offshore survey areas. The current moves in a general east to west direction and as such these areas are less likely to be currently influenced by Negro Bay (with poor circulation and flow) and instead be more influenced by coastal runoff.

The critically endangered *Acropora cervicornis* was seen in several offshore survey areas, including a large thicket, as shown in Figure 6-63. Colony size and health also varied. Several colonies were also seen partially or totally bleached. *Acropora palmata* rubble was seen in areas surrounding the western Negro Bay tip and a small living and partially bleached colony (Figure 6-63) observed on the raised reef of Negro Bay.

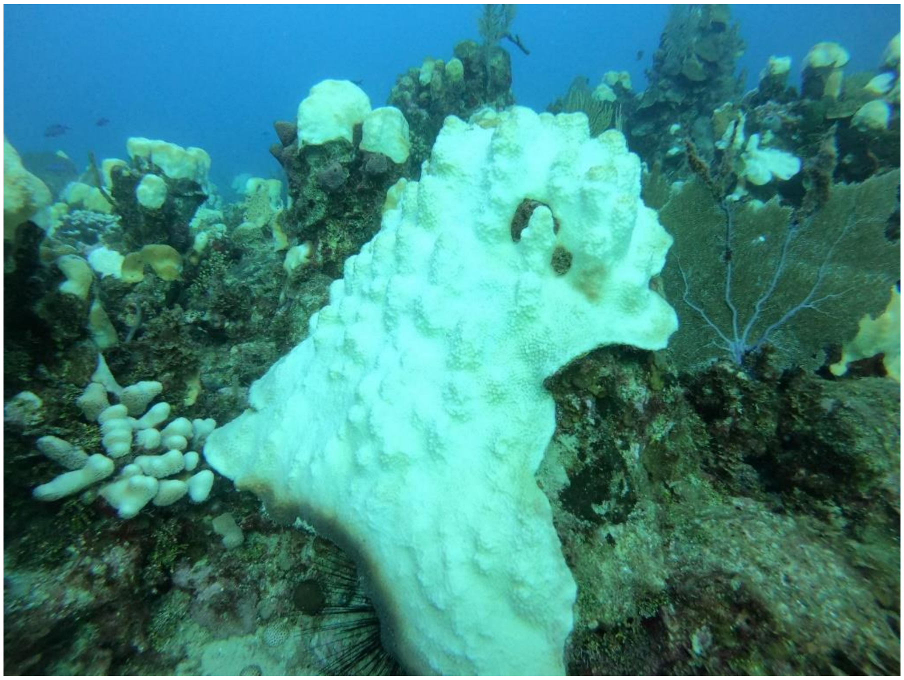


Plate 6-24 Large, bleached *Orbicella* colony

Plate 6-25 Extensive bleaching in survey areas

Plate 6-26 Extensive bleaching in survey areas

Plate 6-27 Diseased *Diploria labyrinthiformis* colony showing rapid tissue loss

Plate 6-28 Bleached Acropora *cervicornis* colonies

Plate 6-29 Large *A. cervicornis* thicket

6.2.2.4 Offshore Fish and Invertebrate Community

Methodology

Fish and invertebrate surveys were conducted along each 100m-long transect line. The transect lines used the existing sediment traps as starting points, moving parallel to the shoreline. (Figure 6-63). A 2m x 2m cube area around was surveyed along the line for fish and a 4m wide belt transect was used for invertebrates covering $800m^3$ and $400m^2$ respectively. Fish data was collected while swimming at a steady pace above the transect line and pausing for 1 minute every 2m. The invertebrate survey was then conducted in opposite direction, swimming along the belt transect. Data was recorded per species, total numbers and size class where possible. A photo inventory and general site observations such as; the presence of fish pots, nets, spear-fishermen, invasive and rare species were also recorded (if any).

Results and Observations

Adult Parrotfish and adult *Diadema* are both important grazers within a reef ecosystem, helping to remove excess algal cover increasing coral survival, reproduction and recruitment. Parrotfish abundance increases slightly, heading westward from Negro Bay towards Green Island Bay, while *Diadema* abundance increased moving eastward from Green Island Bay towards Negro Bay. Plate 6-30 - Plate 6-32 display the fish and invertebrates observed offshore.

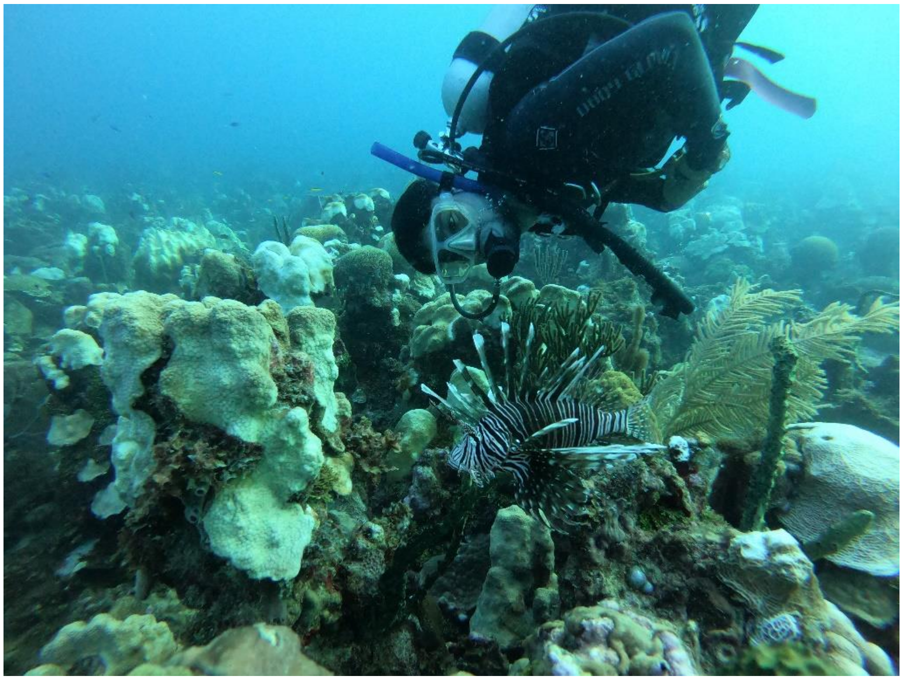


Plate 6-30 Lionfish observed on reef

Plate 6-31 Blue Chromis

Plate 6-32 Fluffy Sea Cucumber

Table 6-27 and Table 6-28 show the various fish and invertebrates respectively, recorded offshore during the reef transect surveys.

Table 6-27 Fish Recorded During Reef Transects

FISH						
Species		Transect 1	Transect 2	Transect 3	Transect 4	Total
Common Name	Scientific Name					
Green Blotch Parrot Fish	*Sparisoma atomarium*	37	12	9	23	81
Striped Parrot Fish	*Scarus iseri*	47	41	40	37	165
Princess Parrotfish	*Scarus taeniopterus*	18	6		1	25
Queen Parrotfish	*Scarus vetula*	2				2
Yellowtail Damsel Fish	*Chrysiptera parasema*	55	36	38	69	198
Royal Gramma	*Gramma loreto*	5	4	0	8	17
Yellowhead Wrasse	*Halichoeres garnoti*	11	5	2	6	24
Butterfly Fish	*Chaetodon sp.*	0	3	1	4	8
Squirrel Fish	*Holocentridae*	1	7	3	2	13
Doctor Fish	*Acanthurus chirurgus*	7	1	0	2	10
Bar Jack	*Carangoides ruber*	2	3	5	2	12
Slippery Dick	*Halichoeres bivittatus*	3				3
Red Hind Grouper	*Epinephelus guttatus*	4	3	1	3	11
Rock Hind Grouper	*Epinephelus adscensionis*	3	0	2	0	5
Yellowtail Snapper	*Ocyurus chrysurus*	8	1	0	0	9
Blue Head Wrasse	*Thalassoma bifasciatum*	114	26	19	74	233
Lionfish	*Pterois sp.*	0	1	0	1	2
Dog Snapper	*Lutjanus jocu*	0	1	1	2	4
Blue Chromis	*Chromis cyaneus*	0	35	0	57	92
Trumpet Fish	*Aulostomus maculatus*	0	0	1	2	3
Porcupine Fish	*Diodontidae sp.*	0	0	1	0	1
Angel Fish	*Pterophyllum sp.*	0	0	0	4	4
Total		317	185	123	297	922

Table 6-28 Invertebrates Observed during Reef Transects

INVERTEBRATES										
Species		Transect 1		Transect 2		Transect 3		Transect 4		
Common Name	Scientific Name	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile	Total
Cleaner Shrimp	*Hippolytidae*	1				1		2		4
Christmas Tree Worm	*Spirobranchus giganteus*	2		3				3		8
Queen Conch	*Strombus gigas*	3		1		1				5
Fan Worm	*Sabella spallanzanii*	3								3
Lettice Leaf Sea Slug	*Elysia crispata*	1								1
Fluffy Sea Cucumber	Astichopus multifidus			1						1
Lobster	*Nephropidae*			1						1
Spiny sea urchin	*Diadema antillarum*	10		10		31	15	55	16	137
Anemone	*Actiniaria sp.*					2				2
Rock Boring Urchin	*Echinometra lucunter*					9		6		15
Fireworm	*Hermodice carunculata*							1		1
Brittle Star	*Ophiuroidea sp.*							1		1
Total		**20**	**0**	**16**	**0**	**44**	**15**	**68**	**16**	**179**

6.2.2.5 Nearshore Fish and Invertebrate Community

Methodology

Roving surveys within the nearshore were conducted and general observations were made. Visibility in Negro Bay was usually poor, while other areas tended to be shallow with moderate wave action.

Results and Observations

Plate 6-33 - Plate 6-37 display the invertebrates observed during the nearshore roving survey. These included: Spotted sea hare, Queen Conch, Sea Star, Ragged Sea Hare and Mud Conch. These are also mentioned in the prior sections in Table 6-24.

Plate 6-33 Spotted Seahare

Plate 6-34 Queen Conch

Plate 6-35 Sea Star

Plate 6-36 Ragged Seahare

Plate 6-37 Mud Conch

6.2.3 Terrestrial and Wetland Fauna

6.2.3.1 Methodology

Avifauna

The Line transect method was utilised for the avian study due to the vast road network, footpaths and the uniformity of most of the vegetation throughout the property. This survey entailed walking along the roads/trails at a steady pace for a given distance while recording all bird species seen or heard (Bibby, C., M. Jones, and S. Marsden. , 1998). The bird species were identified visually and by sound. The Ebird App by Cornel Lab was used to assist with the bird identification using its extensive library of bird species including pictures and audio for the Caribbean including Jamaica. The Cornel Lab Merlin App was also used to identify bird species in the field using photographs. The bird surveys were conducted on September 13-15, 2019, during the daytime and nighttime over 3 days and 2 nights.

The DAFOR scale was used to measure abundance (Table 6-29).

Table 6-29 DAFOR Scale

	Total number of birds observed during the survey
Dominant	≥ 20
Abundant	15 – 19
Frequent	10 – 14
Occasional	5- 9
Rare	< 4

Herpetofauna

The herpetofauna assessment was conducted in areas adjacent to the roads/trails throughout the project area. The primary search points include trees, stone piles, bromeliads, small water bodies and other debris (Plate 6-38 and Plate 6-39). All specimens seen were identified or pictures were taken for laboratory identification if necessary. Some specimens were captured for closer examination. These were placed in glass bottles or catchment containers but were subsequently returned to the habitat. Herpetofauna which could not be identified in the field were collected and identified using Amphibians and Reptiles of Caribbean Islands keys (Caribherp, 2015) and Amphibians and Reptiles of the West Indies (Henderson, 1988). The frogs were also identified by their calls as they usually become vocal at nights or after a rainfall event.


Plate 6-38 Examples of stone piles (left) and wood piles (right) on property which were searched for herpetofauna

Plate 6-39 Example of bromeliad on property which was searched for herpetofauna

Insects

The insect assessment was conducted during daylight over a three-day period. Sampling was conducted primarily in the grassland and mangrove wetland. The possible hiding places for insects within the habitat were carefully searched. These included tree trunks, leaves and dry wood. A sweep net was used to collect insects from the foliage and also flying insects. Night-time assessments consisted of two Robinson's light traps, powered by portable generator. The insects collected were removed, stored in labelled containers and transported to the laboratory for identification at the University of the West Indies Mona. The University has an entomological collection of Jamaican Insects. Most of the insects encountered in the field were identified on the spot; however, insects which could not be identified in the field were collected and identified using entomology collections at the University of the West Indies, Mona.

Plate 6-40 Sweep net used to sample foliage insects

Bats

The bat survey was carried out in two phases. Phase 1; All the possible bat roosts were identified on the property. This include caves, manmade structures and trees. The bat roosting areas and also the bat foraging areas were assessed. Of note bats which could be easily identified to species visually: (Jamaican Fig-eating Bat *Ariteus flavescens* roosting in trees) or by foraging activity (Fishing Bat, *Noctilio leporinus* foraging for fish over a waterbody).

The bat surveys were carried during both in the day and the night:

- In the day the tree canopies on selected trees on the property were assessed for the presence of the endemic Jamaican Fig-eating Bat (*Ariteus flavescens*). The survey was carried out along the sample points and trails used for the fauna assessment.

- In the night the bat survey was carried out along the trails used for the bird survey. This entailed

The main method used for the assessment was the line transect method. This entailed walking along the “transect” (road network on the property) and recording all the bat activity using the AnabatWalkabout detector.

Two AudioMoth acoustic detectors were deployed the device labelled D2 was placed at 3m of the ground on a mangrove within the wetland in the project area (Plate 6-41). It should be noted that the device was in close proximity to a water channel. The water was brackish. The water level within the channel also fluctuates throughout the day as a result of the tide. Several egrets were observed foraging in the area when the water levels fall.

The location of the transect lines and AudioMoth detector locations are listed in Table 6-30 and shown in Figure 6-68.

Plate 6-41 AudioMoth Bat detector placed in the Mangrove wetland

AudioMoth detector labelled D1 was placed in the open grassland (Plate 6-42 and Plate 6-43) area on the property. It was placed at a height 3m on an almond tree overhanging small freshwater pond. Several small egrets were seen in the water.

Plate 6-42 AudioMoth detector D1 deployed in the Grassland

Plate 6-43 AudioMoth detector D1 deployed in the Grassland

Table 6-30 GPS coordinates (JAD2001) of the AudioMoth locations

LOCATION	EASTINGS (JAD2001)	NORTHINGS (JAD2001)
AM_D1	615983.310	695019.288
AM_D2	616640.026	695846.551

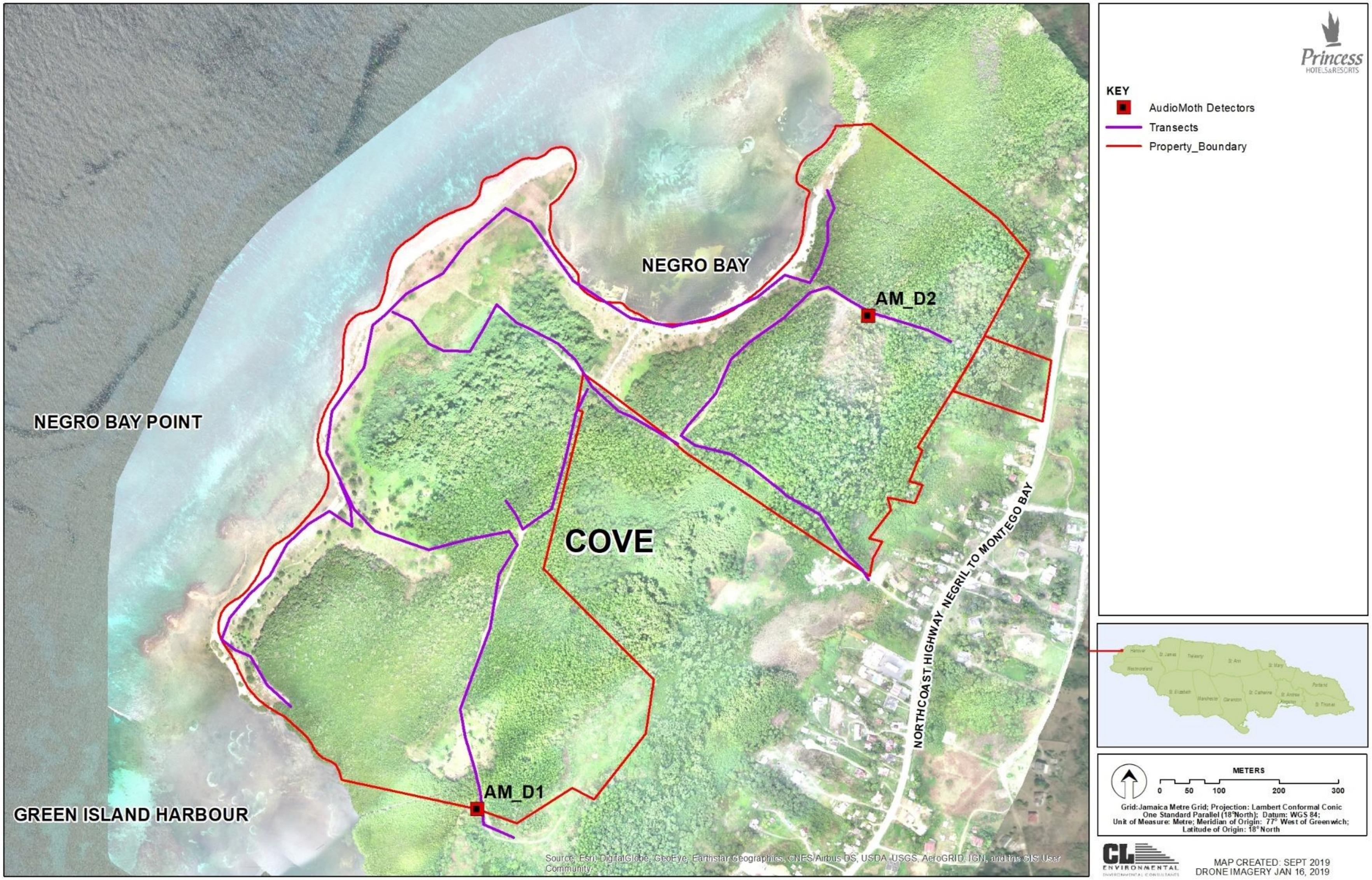


Figure 6-68 Transect and AudioMoth detectors locations

Analysis of the acoustic data

The Kaleidoscope Pro software from Wildlife Acoustics was used ID the bat call from both acoustic devices. The software is generally used to cluster and visualize recordings, automatically identify bats, and analyse sound.

Other Fauna

Other fauna observed on the project property during the assessment were noted and identified where possible. These included mammals, crustaceans and molluscs.

6.2.3.2 Results

Avifauna

The Wildlife Protection Act list twenty animals, excluding the birds as all birds are protected except those considered as pest, domestic animals and the Game Birds.

TERRESTRIAL BIRDS

A total of 35 species of terrestrial birds were observed during the survey. Of the 35 birds identified, 9 were endemic to Jamaica, 4 were endemic subspecies, 8 were migrant species and 14 were resident species (Table 6-31).

Several of the birds observed in the survey are typical of disturbed areas. These species are indicative of anthropogenic disturbances include grass quits, kingbirds, doves, warblers, flycatchers and vireos (Downer & Sutton, 1990). Of the 9 endemic birds, 7 were non-forest dependent and 2 were forest dependent. The 2 forest dependent species were: *Spindalis nigricephala* (Jamaican Spindalis) and *Myiarchus barbirostris* (Sad Flycatcher).

A relatively high number of migrant birds were observed throughout the assessment. This may be attributed to the fact that in Jamaica, bird diversity usually increases from September to May, as a result of the migrant birds.

Table 6-31 Terrestrial Birds observed in the project area

Proper Name	Scientific Name	Occurrence	IUCN Conversation Status	DAFOR
American Kestrel	*Falco sparverius*	Resident	Least Concern	R
American Redstart	*Setophaga ruticilla*	Migrant	Least Concern	O

Proper Name	Scientific Name	Occurrence	IUCN Conversation Status	DAFOR
Bananaquit	*Coereba flaveola*	Endemic subspecies	Least Concern	A
Black-faced Grassquit	*Melanospiza bicolor*	Resident	Least Concern	F
Black-throated blue warbler	*Setophaga caerulescens*	Migrant	Least Concern	R
Common Ground Dove	*Columbina passerina*	Resident	Least Concern	O
Common Yellowthroat	*Geothlypis trichas*	Migrant	Least Concern	R
Greater Antillean Bullfinch	*Melopyrrha violacea ruficollis*	Endemic subspecies	Least Concern	R
Greater Antillean Grackle	*Quiscalus niger*	Resident	Least Concern	O
Jamaican Euphonia	*Euphonia jamaica*	Endemic	Least Concern	O
Jamaican Mango	*Anthracothorax mango*	Endemic	Least Concern	O
Jamaican Oriole	*Icterus leucopteryx*	Endemic subspecies	Least Concern	R
Jamaican Spindalis	*Spindalis nigricephala*	Endemic	Least Concern	R
Jamaican Vireo	*Vireo modestus*	Endemic	Least Concern	O
Jamaican Woodpecker	*Melanerpes radiolatus*	Endemic	Least Concern	O
Loggerhead Kingbird	*Tyrannus caudifasciatus*	Resident	Least Concern	R
Louisiana waterthrush	*Parkesia motacilla*	Migrant	Least Concern	A
Mangrove Cuckoo	*Coccyzus minor*	Resident	Least Concern	R
Northern Mockingbird	*Mimus polyglottos*	Resident	Least Concern	O
Northern Potoo	*Nyctibius jamaicensis*	Resident	Least Concern	R
Northern Waterthrush	*Parkesia noveboracensis*	Migrant	Least Concern	A
Olive-throated parakeet	*Eupsittula nana*	Endemic	Least Concern	F
Prairie Warbler	*Setophaga discolor*	Migrant	Least Concern	O
Red-billed Streamertail	*Trochilus polytmus*	Endemic	Least Concern	O
Sad Flycatcher	*Myiarchus barbirostris*	Endemic	Least Concern	R
Smooth-Billed Ani	*Crotophaga ani*	Resident	Least Concern	O
Turkey Vulture	*Carthartes aura*	Resident	Least Concern	O
Vervain Hummingbird	*Mellisuga minima*	Endemic subspecies	Least Concern	O
White-chinned Thrush	*Turdus aurantius*	Endemic	Least Concern	R
White-crowned pigeon	*Patagioenas leucocephala*	Resident	Least Concern	F
White-winged dove	*Zenaida asiatica*	Resident	Least Concern	F
Worm-eating warbler	*Helmitheros vermivorus*	Migrant	Least Concern	O
Yellow Warbler	*Setophaga petechia*	Migrant	Least Concern	A
Yellow-faced Grassquit	*Tiaris olivacea*	Resident	Least Concern	F
Zenaida Dove	*Zenaida aurita*	Resident	Least Concern	F

Plate 6-44 shows a photograph taken of a Northern Potoo during the night-time survey.

Plate 6-44 Northern Potoo observed during night survey

WETLAND BIRDS

All birds are protected except game birds and pests, the West Indian Whistling Duck is of particular importance as it considered an endangered species and therefore of conservation significance. A total of 18 wetland birds were observed during the survey, 16 of which were resident species and 2 which were migrant species (Table 6-32). Herons were seen foraging in the waterlogged areas of the mangrove forest, as well as on the coast at low tide. During the first night assessment, three (3) West Indian Whistling Ducks (*Dendrocygna arborea*) were observed in small pool on the property (Plate 6-45). The most common species observed on the coast was the cattle egret (*Bubulcus ibis*).

Table 6-32 Wetland birds observed in the project area

Proper Name	Scientific Name	Occurrence	IUCN Conversation Status	DAFOR
American Bittern	*Botaurus lentiginosus*	Resident	Accidental	R
Black-Crowned Night Heron	*Nycticorax*	Resident	Least Concern	O
Cattle Egret	*Bubulcus ibis*	Resident	Least Concern	F
Glossy ibis	*Plegadis falcinellus*	Resident	Accidental	O
Great Blue Heron	*Ardea herodias*	Migrant	Least Concern	O
Great egret	*Ardea alba*	Resident	Least Concern	O
Green Heron	*Butorides virescens*	Resident	Least Concern	O
Killdeer	*Charadrius vociferus*	Resident	Least Concern	R
Little Blue Heron	*Egretta careulea*	Resident	Least Concern	O
Reddish Egret	*Egretta rufescens*	Resident	Accidental, Near-threatened	R
Snowy Egret	*Egretta thula*	Resident	Least Concern	R
Solitary Sandpiper	*Tringa solitaria*	Migrant	Least Concern	R
Tricolored heron	*Egretta tricolor*	Resident	Least Concern	R
West Indian whistling-duck	*Dendrocygna arborea*	Resident	Vulnerable	R
White ibis	*Eudocimus albus*	Resident	Least Concern	R
Willet	*Tringa semipalmata*	Resident	Least Concern	R
Wilson's Plover	*Charadrius wilsonia*	Resident	Least Concern	R
Yellow-Crowned Night Heron	*Nycticorax violaceus*	Resident	Least Concern	O

Plate 6-45 Pool where three West Indian Whistling Ducks were observed during night survey

Plate 6-46 Willet observed foraging in the nearshore waters

Herpetofauna

AMPHIBIANS

There are approximately 27 species of amphibians found in Jamaica. During this study only 2 species were observed (Table 6-33). The introduced *Eleutherodactylus johnstonei* was heard calling throughout the property. They were also observed on the vegetation and also in a few of the rock piles. A few were heard calling during the daytime after the rainfall.

The endemic *Eleutherodactylus cundalli* (Plate 6-47) was observed only in the tank bromeliads which were growing on several of the mangroves on the property. This frog was identified acoustically during the nocturnal survey and during the removal of several of tank bromeliads. Both adults and tadpoles were observed.

Plate 6-47 *Eleutherodactylus cundalli* which was found in a bromeliad

REPTILES

American Crocodile has been observed in the project area. They are listed as are considered an endangered species and are protected under the Wildlife Protection Act; they have been reported on site by locals. The team thoroughly assessed the coastline for crocodiles in the day and during the night (eyeshine checks), however, no crocodiles were observed. During the first night assessment, the team encountered tracks on the beach which highly resemble that of the crocodile (*Crocodylus acutus*) (Plate 6-48).

Plate 6-48 Possible crocodile tracks observed on beach during night survey

Four (4) species of reptiles were confirmed during the study (Table 6-33). All the reptiles identified were *Anolis (*Plate 6-49*)*. No ground dwelling reptiles (snakes or galliwasps) were observed on the property. This could be as a result of the waterlogged nature of the project site. It should be noted that the status of *all* endemic reptilian and amphibian species are of concern primarily due to the distribution of their populations which is limited throughout Jamaica.

Plate 6-49 *Anolis grahami* lizard observed

Table 6-33 Herpetofauna observed in project area

Species	Common name	Species Status	IUCN Conservation Status	DAFOR
AMPHIBIANS				
Eleutherodactylus johnstonei	Lesser Antillean Frog	Introduced	Least concern	D
Eleutherodactylus cundalli	Jamaican Rock Frog	Endemic	Vulnerable.	F
REPTILES				
Anolis garmani	Jamaican Giant Anole	Endemic	Near threatened	O
Anolis grahami	Jamaican Turquoise Anole	Endemic	Near threatened	O
Anolis lineatopus	Jamaican Grey Anole	Endemic	Near threatened	D
Anolis sagrei	Cuban Brown Anole	Introduced	Not Assessed	O
Crocodylus acutus	American Crocodile		Vulnerable	Not confirmed

Insects

Daytime Survey

Over 51 species of insects were identified, including 25 species of butterflies. There was a total of 26 unidentified species which were classified down to the Family taxonomic level and a DAFOR rating assigned (Table 6-34). The species listed are all widespread, most of which are associated with open fields/areas. Of the arthropods observed on the property, no species were identified with any special conservation needs.

Table 6-34 Invertebrates observed in the project area

Order & Family	Species	Common Name	DAFOR	Distribution/Comments
LEPIDOPTERA				
Arctiidae	*Empyreuma anassa*		R	Jamaican endemic, widespread
Danaidae	*Danus plexippus*	Monarch	R	Widespread West Indies and North and South America
Heliconiidae	*Heliconius charitonius simulator*	The Zebra	O	Endemic subspecies; from Montserrat to Andros Island, Bahamas

Order & Family	Species	Common Name	DAFOR	Distribution/Comments
	Dione vanilla vanillae		O	Widespread in West Indies
	Dryas iulia delia	Julia	F	Widespread, West Indies & America
Hesperiidae	*Pyrgus oileus*	Syrichtus	O	Occurs in southern U.S., Mexico, Costa Rica and Isles of the West Indies
	Wallengrenia otho vesuria	Vesuria	R	Subspecies endemic to Jamaica
	Mestra dorcas	Dorcas	O	Endemic to Jamaica, widespread.
	Eurema messalina		O	Non-endemic; occurs in Cuba, Bahamas, Cayman
	Ascia monuste	Antillean Great white	F	Common throughout West Indies
	Appias drusilla	Jamaican Albratross	O	Widespread West Indies and North and South America
	Chiodes catillus churchi	Jamaican Skipper	O	Widespread West Indies and North and South America
Nymphalidae	*Anartia jatrophae*	The Jamaican White Peacock	O	
	Anteos maerula		R	Widespread West Indies and North and South America
	Mestra Dorcas	Dorcas	O	Endemic to Jamaica, widespread.
	Phoebis sennae	Cloudless Sulphur	O	
Lycaenidae	*Hemiargus dominica*	The Jamaican Blue	O	
	Leptotes Cassius theonus	The Cassius Blue	R	In season widespread and common
Pieridae	*Eurema daira Palmira*	Poey’s Barred Sulphur	F	In season widespread and common
	Eurema nise	Cramer’s Little Sulphur	O	West Indies
	Phoebis senae			
Papilionidae	*Papilio andraemon*	Cuban Swallowtail	O	Introduced, Cuba, Bahamas and Florida
Noctuidae	*unidentified species*		O	
Psychidae	*unidentified species*		F	

Order & Family	Species	Common Name	DAFOR	Distribution/Comments
ORTHOPTERA				
Tettigoniidae – Conocephalinae	*unidentified species*	Meadow Grasshoppers	A	
Acrididae	*Orphulella punctata*	Short-Horned Grasshoppers	A	
Chrysomelidae	*Brachyacantha bistriputulata*		R	Widespread
Curculionidae	*Euscelus bipustulosus*		O	
Bruchidae	*unidentified species*		R	
COLEOPTERA				
Coccinellidae	*Cycloneda sanguinea*		A	
	Scymnus rosecollis		A	
Chrysomelidae	*Brachyacantha bistriputulata*		O	
	Cerotoma ruficornis		O	
Alticinae	unidentified species	Flea Beetles	F	
Chrysomelidae	*Diabrotica bivittata*		R	
Lycidae	*Neolomaea tropica*	Net-Winged Beetles	R	
Curculionidae	*Euscelus bipustulosus*		O	
Bruchidae	unidentified species		R	
HOMOPTERA				
Cicadellidae	*Hortensia similis*	Leafhoppers	F	
Delphacidae	unidentified species	Delphacid Planthoppers	F	
Cixiidae	unidentified species	Cixiid Planthoppers	A	

Order & Family	Species	Common Name	DAFOR	Distribution/Comments
Membracidae	unidentified species		A	
Cixiidae	unidentified species	Planthoppers	R	
Aphididae	unidentified species		A	
HEMIPTERA				
Lygaeidae	unidentified species	Seed Bugs	D	
Miridae	unidentified species	Leaf or Plant Bugs	F	
Tingidae	unidentified species	Lace Bugs	R	
Pentatomidae	unidentified species	Stink Bugs	O	
Reduviidae	*Zelus longipes*	Assassin Bug	R	
HYMENOPTERA				
Apidae	*Apis mellifera*	Honeybee	F	
Vespidae	*Polistes hunteri*	Paper Wasps	R	
Formicidae	unidentified species		D	
Vespidae	*Pachodynerus jamaicensis*		R	
	Polistes hunteri		R	
Chalcididae	*Brachymera* sp.		R	
Pteromalidae	unidentified species	Pteromalids	R	
Eulophidae	unidentified species		R	
Megachilidae	unidentified species	Leaf-Cutting Bees	R	
Eurytomidae	unidentified species	Seed Chalcid	R	
DIPTERA				
Lonchaeidae	unidentified species	Lonchaeid Flies	F	

Order & Family	Species	Common Name	DAFOR	Distribution/Comments
Otitidae	unidentified species	Picture Winged Flies	O	
Agromyzidae	unidentified species	Leaf Miner Flies	O	
Dolichopodidae	unidentified species		O	
Syrphidae:	unidentified species		F	
Tachinidae	unidentified species		O	
ODONATA				
	Anisoptera Libellulidae	*Tramea binotata*	O	
		Erythemis plebja	A	
	Zygoptera: Coenagrionidae	*Telebasis dominicanum*	O	
	Anisoptera Libellulidae	*Tramea binotata*	R	

Plate 6-50 A termite mound observed in the project area

Night-time Survey

Twenty seven species of insects (Table 6-35) were collected during this exercise. On species, *Dione vanelliae*, is a butterfly and is not nocturnal; this specimen might have been disturbed from its resting place.

Three species of moths were collected, one belonging to the family Noctuidae and two from the Geometridae. While there has been research on these families in Jamaica there is still considerable work to be done and consequently the status of these moths are unknown. The Coleoptera (beetles) was the most diverse group (9 species) while the Diptera (flies) with 5 species was the most numerous.

The diversity of insects was low. This however is likely to be the result of the relatively harsh environment of provided by a mangrove swamp and seashore vegetation. While the status of many species is unknown, we have no basis to recommend any species for specific conservation consideration.

Table 6-35 Night-time insects observed in the project area

Order and Family	Species and number of specimens	Common Name	DAFOR Rating	IUCN
LEPIDOPTERA: **Heliconiidae**	*Dione vanillae*	Tropical Silverspot	R	Not Assessed
Geometridae	1 unidentified species, 1 specimen	Moth		
Noctuidae	2 unidentified species, 1 specimen of each	Moth	R	
ORTHOPTERA: **Tettigoniidae – Phaneropterinae**	1 unidentified species: 10	Bush and Round-headed Katydids	R	
DIPTERA: Agromyzidae	1 species, more than 69 specimens	Leaf-miner Flies	D	
Sciaridae	1 species, 42 specimens	Dark-winged Fungus Gnat	A	
Lauxaniidae	1 species, 6 specimens	Lauxaniid Flies	O	

Lonchaeidae	1 species, 3 specimens	Lonchaeid Flies	O	
Otitidae	1 species, 1 specimen	Picture-winged Flies	R	
COLEOPTERA: **Chrysomelidae**	1 species, 1 specimen	Leaf Beetles	R	
Noteridae	4 species, 1specimen each	Burrowing Diving Beetles	R	
Heteroceridae	1 species, 1 specimen	Variegated Mud-Loving Beetle	R	
Platypodidae	1 species, 2 specimens	Pinhole Borers		
1 unclassified beetle species (Possible Byrrhidae-Pill Beetles)	1 species, 14 specimens		F	
Curculionidae	1 species, 2 specimens	Snout Beetles	O	
HOMOPTERA: **Cicadellidae**	5 species, 2 specimens of 1 species, 1specimen each of 4 species	Leafhopper	O	
Delphacidae	1 species, 1 specimen	Delphacid Planthoppers	R	
HYMENOPTERA: Sphecidae	1 species, 1 specimen		R	
ODONATA: **Anisoptera**	1 species, 1 specimen	Dragonfly	R	

Bats

As part of CITES, enacted in 2000, Jamaica was able to regulate the movement of wild flora and fauna into and out of Jamaica. Four schedules are listed under the Act, of which three are Appendices of the CITES convention and the fourth includes species not listed by the Convention for which Jamaica wishes protection. Nine of Jamaica's bat species are found on this Schedule and includes *Ariteus flavescens, Brachyphylla nana, Mormoops blainvillii, Phyllonycteris aphylla, Pteronotus macleayi, Pteronotus quadridens, Tadarida brasiliensis, Natalus micropus* (which was re-described as *Chilonatalus micropus*) and *Natalus stramineus*. Any request to collect or export any of these species is reviewed to determine whether such a trade would be detrimental to the survival of the species" (Ecosystems Management Branch NEPA, 2011).

Twenty one species of bats from 6 families are found in the island of Jamaica (**Error! Reference source not found.**). These bats are known to roost in various habitats ranging from caves, manmade structures, rock crevices and trees (canopies and cavities). The majority of the bat species roost in caves (n=15) and the other roost in trees and manmade structures (Genoways , Bickham , Baker, & Phillips, 2005).

Information on bats in Jamaica is extremely limited, in 2005 Genoways et al listed in the Parish of Hanover. The study found the following, (including the trophic); Frugivore (n=1), Piscivore (n=1), Insectivore (n=6) and Nectarivore (n=3).

- Nectarivore: Few flowering plants were observed on the property so little nectarivore is expected to forage on site. The critically endangered Jamaican Flower bats have been reported in the Parish of Hanover. It is only found in one cave in Portland and it would be unlikely to be found on the site.

- Frugivore: The Jamaican Fruit Bat (*Artibeus jamaicensis*) were identified with the use of the headlight were observed foraging on the almond trees with ripe fruits on the coastal section of the property. A few of the individuals drop the almond under tree during the survey. It is listed as least Concern by the IUCN.

- Piscivore: The Fishing Bat (*Noctilio leporinus*) were observed foraging on the coastal water in the study. It is listed as least Concern by the IUCN.

- Insectivore: Several bats were observed foraging very low 2.5 m above the wetland vegetation where swarms of flies were observed. The bats could not be identified to species; however, they were feeding on the flies in open space. There are over 14 insectivorous bats found in Jamaica and 6 species reported in the parish Hanover (Genoways , Bickham , Baker, & Phillips, 2005). 5 of 6 the species are listed by IUCN as Least Concern and 1 species, Cuban Lesser Funnel-eared Bat listed as Vulnerable. It is possible that the unknown bats could be from the Molossidae family which are known to forage in open space.

Phase 1 Survey

Bats were observed during the nocturnal assessment on the property (Table 6-36). The survey was conducted along the paths/roads on the property. Several bats were observed during the walkthrough however, only species that could be identified were recorded. Damaged almonds were observed on the ground possibly as a result of feeding fruit bats (*Artibeus jamaicensis*) (Plate 6-51). No caves nor manmade structures that bats roost in were observed on the property. In addition, the endemic fig eating bat was not observed roosting in the tree canopies that were investigated.

Table 6-36 Bat species observed on property during nocturnal assessment

Species	Common name	Range	Habitat Observed
Noctilio leporinus	Fishing Bat	Neotropics	Foraging on the coastal waters on the property
Artibeus jamaicensis	Jamaican Fruit Bat	Neotropics	Several damage almond seeds were seen below the almond trees. Bats were also seen going after the fruits on the almond trees.
Pteronotus macleayii	Macleay's mustached bat	Cuba and Jamaica	The bats were observed foraging very low 2.5 m above the wetland vegetation where swarms of flies were observed. The flies were attracted to the lights and the bats were identified clearly when they were going after the flies.

Plate 6-51 Damaged almonds as a result of feeding fruit bats (*Artibeus jamaicensis*)

Phase 2 survey

The bat call library could only account for 9 of the 21 species found in Jamaica. Other bat calls were obtained from acoustic material from Windsor Research Centre (Koenig, 2015), personal library and also from Google if needed. In addition, the software will note bat calls that are not in the software's Call library.

Table 6-37 Call Library Species Identification

Family	SPECIES	CODE	COMMON NAME	Diet	Range	Kladescope Call Library
Phyllostomidae	*Artibeus jamaicensis*	ARTJAM	Jamaican Fruit Bat	Frugivore	Native	Windsor research centre
Noctilionidae	*Noctilio leporinus*	NOCLEP	Fishing Bat	Piscivore	Native	Yes
Mormoopidae	*Mormoops blainvillei*	MORBLA	Antillean Ghost-faced Bat	Insectivore	Native	Yes
Mormoopidae	*Pteronotus parnellii*	PTEPAR	Parnell's Mustached Bat	Insectivore	Native	Yes
Mormoopidae	*Pteronotus macleayii*	PTEMAC	MacLeay's Mustached Bat	Insectivore	Native	Yes
Mormoopidae	*Pteronotus quadridens*	PTEQUA	Sooty Mustached Bat	Insectivore	Native	Yes
Phyllostomidae	*Monophyllus redmani*	MONRED	Leach's Single Leaf Bat	Nectarivore	Native	Windsor research centre
Phyllostomidae	*Erophylla sezekorni*	EROSEZ	Brown Flower Bat	Nectarivore	Native	Personal library
Phyllostomidae	***Phyllonycteris aphylla***	**PHYAPH**	**Jamaican Flower Bat**	**Nectarivore**	**Endemic**	

Natalidae	*Chilonatalus micropus*	CHIMIC	Cuban Lesser Funnel-eared Bat	Insectivore	Native	Internet
Molossidae	*Molossus*	MOLMOL	Pallas' Mastiff Bat	Insectivore	Native	Yes
Phyllostomidae	*Macrotus waterhousii*	MACWAT	Big-eared Bat	Insectivore	Native	Internet
Phyllostomidae	*Glossophaga soricina*		Pallas' Long-tongued Bat	Nectarivore	Native	Windsor research centre
Phyllostomidae	***Ariteus flavescens***		**Jamaican Fig-eating Bat**	**Frugivore**	**Endemic**	Windsor research centre
Natalidae	***Natalus jamaicensis***	**NATJAM**	**Jamaican Funnel-eared Bat**	**Insectivore**	**Endemic**	
Vespertilionidae	*Eptesicus fuscus*	EPTFUS	Big Brown Bat	Insectivore	Native	Internet
Vespertilionidae	***Lasiurus degelidus***	**LASDEG**	**Jamaican Red Bat**	**Insectivore**	**Endemic**	
Molossidae	*Tadarida brasiliensis*	TADBRA	Free-tailed Bat	Insectivore	Native	Yes
Molossidae	*Nyctinomops macrotus*	NYCMAC	Big Free-tailed Bat	Insectivore	Native	Yes
Molossidae	*Eumops auripendulus*	EUMAUR	Black Bonneted Bat	Insectivore	Native	
Molossidae	*Eumops glaucinus*	EUMGLA	Wagner's Bonneted Bat	Insectivore	Native	Yes

Ten species of bats were identified using the Kladescope Pro Acoustic software. The species, trophic guild include: Frugivore (n=1), Piscivore (n=1), Insectivore (n=7) and Nectarivore (n=1). There were no endemic bats or bat with special protection or deemed endangered.

The Piscivore bat *Noctilio leporinus* were detected at both the fresh and salt water bodies in the study. They were not detected in the mangrove forest. The Frugivore, *Artibeus jamaicensis* were detected in the open grassland on the coast where there were several almond trees with fruit.

Glossophaga soricina was the only nectarivore detected in the study. Their activity was detected in open grassland where there was a fresh water body. It is possible that the bat was drinking water from the small pond. Limited flower plants were observed in the study area and it could not be deduced if the bat was foraging in the area.

Of the 7 insectivorous bat detected, 5 are known to forage in forested areas. While the other 2 species are known to forage in open areas: *Tadarida brasiliensis* and *Molossus molossus*. It should be noted that *Tadarida brasiliensis* was only detected near the light trap. The light trap was used to attract insects with light. It’s possible that the bat was feeding on the insects.

Limited studies have been carried out on bats in Jamaica, a study was carried out by Genoways et al 2005 identified 10 species of bats. Of note the critically endangered Jamaican Flower bats have been reported in the Parish of Hanover. It is only found in one cave in Portland and it would be unlikely to be found on the site.

The bat species found in Jamaica, species reported in the parish of Hanover (Genoways, et al. 2005) and species identified during the study. Table 6-38 was generated from information from Genoways et al 2005, Koenig 2015, IUCN Redlist 2019 and Wikipedia 2019

Table 6-38 Bat species found in Jamaica, those reported in Hanover by (Genoways , et al. 2005) and those observed on site along with their IUCN Categorization

SPECIES	COMMON NAME	Diet	IUCN	Range	ROOST	Reported in Hanover	Bat Observed in the study	Foraging Behaviour
Artibeus jamaicensis	Jamaican Fruit Bat	Frugivore	Least concern	Native	Cave, man-made structure, foliage		Yes	Fruit Feeder: trees in forested and disturbed area
Noctilio leporinus	Fishing Bat	Piscivore	Least concern	Native	Cave, crevice, Tree hollow	Yes	Yes	Slow-moving water surface; along edge and open fields
Moormops blainvillei	Antillean Ghost-faced Bat	Insectivore	Least concern	Native	Obligate cave	Yes	Yes	semi-cluttered space; fluttering hunter
Pteronotus parnellii	Parnell's Mustached Bat	Insectivore	Least concern	Native	Obligate cave	Yes	Yes	Highly cluttered space; fluttering hunter
Pteronotus macleayii	MacLeay's Mustached Bat	Insectivore	Least concern	Native	Obligate cave	Yes	Yes	Background-cluttered space; fluttering hunter

Pteronotus quadridens	Sooty Mustached Bat	Insectivore	Least concern	Native	Obligate cave	Yes	Yes	Background-cluttered space
Monophyllus redmani	Leach's Single Leaf Bat	Nectarivore	Least concern	Native	Obligate cave	yes		Nectar Feeder: trees in forested and disturbed area
Erophylla sezekorni	Brown Flower Bat	Nectarivore	Least concern	Native	Obligate cave	yes		Nectar Feeder: trees in forested and disturbed area
Phyllonycteris aphylla	**Jamaican Flower Bat**	**Nectarivore**	**Critically Endangered**	**Endemic**	**Obligate cave**	**Yes**		Nectar Feeder: trees in forested and disturbed area
Chilonatalus micropus	Cuban Lesser Funnel-eared Bat	Insectivore	Vulnerable	Native	Obligate cave	yes		Cluttered space; fluttering hunter
Molossus	Pallas' Mastiff Bat	Insectivore	Least concern	Native	Cave, man-made structures	yes	Yes	Open-space, aerial awking
Macrotus waterhousii	Big-eared Bat	Insectivore	Least concern	Native	Cave, man-made structure			Cluttered space
Glossophaga soricina	Pallas' Long-tongued Bat	Nectarivore	Least concern	Native	Cave, man-made structure		Yes	Nectar Feeder: trees in forested and disturbed area

Ariteus flavescens	**Jamaican Fig-eating Bat**	**Frugivore**	**Least concern**	**Endemic**	**Tree crown**			**Fruit Feeder: trees in forested and disturbed area**
Natalus jamaicensis	**Jamaican Funnel-eared Bat**	**Insectivore**	**Critically Endangered**	**Endemic**	**Obligate cave**			**Cluttered space; fluttering hunter**
Eptesicus fuscus	Big Brown Bat	Insectivore	Least concern	Native	Obligate cave			
Lasiurus degelidus	**Jamaican Red Bat**	**Insectivore**	**Vulnerable**	**Endemic**	**Foliage**			
Tadarida brasiliensis	Free-tailed Bat	Insectivore	Least concern	Native	Cave, man-made structures		Yes	Open-space, aerial awking
Nyctinomops macrotus	Big Free-tailed Bat	Insectivore	Least concern	Native	Cave, crevices		Yes	
Eumops auripendulus	Black Bonneted Bat	Insectivore	Least concern	Native	Cave, loose tree bark,			
Eumops glaucinus	Wagner's Bonneted Bat	Insectivore	Least concern	Native	Cave,man-made structures			Open-space, aerial awking

Other Fauna

Several cats and dogs were observed on the property. Other fauna observed included: Purple land crab (*Gecarcinus ruricola*), Blue Land Crab (*Cardisoma guanhumi*), Caribbean hermit crabs (*Coenobita clypeatus*), Mangrove Tree Crab *(Aratus pisonii),* Fiddler crab (Uca sp.) and coffee snails (*Melampus coffea*).

Plate 6-52 Purple land crab (*Gecarcinus ruricola*)

Plate 6-53 Blue Land Crab (*Cardisoma guanhumi*)

Plate 6-54 Caribbean hermit crabs (*Coenobita clypeatus)*

6.3 MANGROVE COMMUNITY

The proposed project area and surrounding wetland and coastal areas are still used as a hunting site for game birds (see Plate 6 37). The proposed, Princess Hotel site is currently a healthy, mature and ecologically functional wetland system. The observed ecology of the area supports the expected services of a medium to large mangrove forest. Mangrove forest like these areas play vital roles in regulating, supporting, provisioning and providing cultural benefits (M.K. Webber et. al., 2014). The NEPA 2013 report states that Mangrove forests provide a wide array of ecological services that contribute to the wellbeing of the ecosystem. A list of some ecological services of mangroves, specifically those observed at the proposed project site, are as follows:

- Bird Habitat (breeding)
- Bird feeding ground
- Crustacean, insect and reptile Habitat
- Water retention
- Nutrient Filtration
- Sediment trapping
- Prevention of saltwater intrusion
- Human food source
- Provision of wood for fuel, construction and fishing
- Cultural uses (crab hunting and bird shooting)
- Coastal Buffer Zone (storm and erosion control)
- Nursery for juvenile marine organisms
- Carbon sequestering

The preservation of these ecological character and aesthetics were determined to be the area to be of unique, with local and national importance and consequently require special planning considerations. that cannot be analogous with planning guideline for other areas.

6.3.1 Methodology

The ecological survey of mangroves/wetland areas directly within the impact areas of the proposed hotel development was conducted over a four-day period; September 7 – 8 and September 14 – 15, 2019. To sample various forested areas of the property, data were collected from twenty-one (21) discrete belt transects at select locations on the property (Figure 6-69). The following data was collected within each transect:

- Standing water depth and salinity (middle of the transect)
- Visible fauna noted
- Mangrove tree species and numbers within sample area
- Mangrove tree heights (m) for up to 5 of each species present inside each transect
- Non-mangrove tree species presence, summarized in the DAFOR ranking
- Diameter at breast height (DBH) in cm, for up to 5 of each species present

- Density of mangrove seedlings within 1 m^2. This was conducted in a randomly selected patches within the sample area.

Additional data was collected by deploying water level data loggers at strategic locations. The water level loggers were secured on the substrate surface and recorded water temperature and pressure of water above the device (in PSI) in 15-minute intervals, which were converted into depth (cm). This provides evidence on the influence of water on the forest over a specified time.

Figure 6-69 Map showing mangrove survey transect locations and northern wetland boundary

6.3.2 Results

6.3.2.1 Historical Satellite Imagery

The mangrove forest shows strong evidence of previous human disturbances in the last 20 years. A review of satellite imagery (Figure 6-70) shows a marked difference in the presence of road networks, points of vegetation changes/disturbance and built structures north of the project footprint (emanating from the highway).

Figure 6-70 Satellite imagery of the changes of the proposed site area between 2003 and 2018

6.3.2.2 Mangrove Survey Data

The vegetation on the project property is predominantly mangrove forest, consisting of mostly black mangrove (*Avicennia germinans*) especially in the interior of the project area and to a lesser extent red mangrove (*Rhizophora mangle*), mainly along the coastline.

The total area of wetland/mangrove forest sampled was 4900m². Based on the density of trees recorded in each zone, a mangrove tree density was recorded for each sector. The mean tree density derived from all areas was 0.13 adult mangrove trees per m². The forest may be characterized as a very mature mangrove forest system, showing traditional and expected Caribbean mangrove forest tree zonation (from land to sea: *Rhizophora sp.; Avicennia sp.: Laguncularia sp.* progression) and a high presence of mangrove/golden ferns (regarded as mangrove plants worldwide, but listed as invasive species in Jamaica) interspersed within the mangrove forest areas. The forest is interspersed with other emergent wetland vegetation in strictly freshwater areas (*Typha sp, Dalbergia sp,* and *Spartina sp.)* to the north and south primarily.

The highest density of trees was found in the Transect 7 area. This area has a high density of Red mangrove trees, living in a very saline environment (40 ppt), which result in the trees not attaining much height. A similar condition of trees is found on the opposite north-eastern side of the property (at Transects 9 and 10 with similar saline influence and species composition. Areas with strictly saline influence exhibited generally shorter trees. Transect 9, near the northeast boundary, is a complete red mangrove forest. West of this transect in shallow waters, was the occurrence of seagrass beds, coral colonies (*Siderastrea siderea, Porites asteroides*) and giant anemones.

The tallest trees with the most girth (DBH) were located in Transects 2 and 12. Areas influenced primarily by freshwater flows showed taller trees with larger trunks/girth.

It was observed that *Avicennia germinans* (black mangroves) are generally taller than other species on the property. These trees showed very impressive heights especially in the Transect 6 area, which was comprised almost exclusively of black mangrove trees. This central location showed the highest depth of standing water, in an almost exclusively black mangrove dominated forest (also seen in neighbouring Transect 4).

Table 6-39 and Table 6-40 display the various mangrove data collected.

Table 6-39 Adult mangrove tree density and transect survey area (with density per m^2)

Transects	*Avicennia germinans* (Black mangrove)	*Laguncularia racemosa* (White mangrove)	*Rhizophora mangle* (Red mangrove)	Total trees	Area surveyed	Density (per m^2)
Transect 1	21	10	9	40	400	0.1
Transect 2	0	2	4	6	100	0.06
Transect 3	135	0	0	135	400	0.34
Transect 4	47	0	0	47	400	0.12
Transect 5	4	8	47	59	400	0.15
Transect 6	67	1	0	68	400	0.17
Transect 7	1	0	62	63	100	0.63
Transect 8	0	3	11	14	100	0.14
Transect 9	0	0	23	23	100	0.23
Transect 10	0	1	11	12	400	0.03
Transect 11	1	0	10	11	100	0.11
Transect 12 (Main Road A)	5	0	2	7	200	0.035
Transect 13 (Main Road B)	17	1	0	18	200	0.09
Transect 14 (Main Road C)	6	2	0	8	200	0.04
Transect 15 (Main Road D)	7	3	4	14	200	0.07
Transect 16 (Main Road E)	1	0	3	4	200	0.02
Transect 17 (Main Road F)	0	14	8	22	200	0.11
Transect 18 (Service Road A)	0	2	0	2	200	0.01
Transect 19 (Service Road B)	1	8		9	200	0.05
Transect 20 (Service Road C)	12	10	9	31	200	0.16
Transect 21 (Service Road D)	0	9	9	18	200	0.09

Table 6-40 Average mangrove tree heights, DBH, Salinity, Water Depth and Seedling Density

Transects	Avg. Tree height (m)	Avg. Diameter at breast height (cm)	Water depth (m)	Salinity (ppt)	Seedling Density (per m^2)
Transect 1	14.33	23.3	0.2	0	_
Transect 2	13.7	44	_	0	6 red
Transect 3	11	23.5	0.05	35	21 black
Transect 4	18	26.5	0.25	0	21 black
Transect 5	7.3	17.3	0.05	36	19 red

Transects	Avg. Tree height (m)	Avg. Diameter at breast height (cm)	Water depth (m)	Salinity (ppt)	Seedling Density (per m^2)
Transect 6	17.6	27.6	0.22	0	53 black
Transect 7	7.3	15	0.04	40	_
Transect 8	11.3	30	0.1	3	21 red
Transect 9	6	8.1	0.5	40	2 red
Transect 10	5.5	10.8	0.03	35	_
Transect 11	11	13.6	0.14	3	_
Transect 12 (Main Road A)	13.5	37	0.10	5	42 black
Transect 13 (Main Road B)	11.5	29.5	0.05	5	200+ black
Transect 14 (Main Road C)	14	28.3	0.05	5	45 black
Transect 15 (Main Road D)	16	21.66	0.12	5	-
Transect 16 (Main Road E)	12.3	20.33	-	-	-
Transect 17 (Main Road F)	11	14	-	-	-
Transect 18 (Service Road A)	11.5	12.5		3	-
Transect 19 (Service Road B)	11	18.25		5	300+ black
Transect 20 (Service Road C)	10.33	16.23		15	30 black,15 Red
Transect 21 (Service Road D)	9	13.4		25	-

Plate 6-55 to Plate 6-60 show photos of mangroves in some of the various transects surveyed.

Plate 6-55 Section of Transect 2

Plate 6-56 Transect 3 Dense Black Mangrove Forest

Plate 6-57 Section of Transect 4

Plate 6-58 Section of Transect 5

Plate 6-59 Transect 7 - Red mangroves with stagnant and hypersaline water in foreground

Plate 6-60 Section of forest showing dense mangrove network

6.3.2.3 Visible Hydrology and Tidal Influence

The extent of the wetland displays a complex hydrological regime with the northeastern and southwestern sections tidally influenced, the southeastern sections are primarily riverine in influence and some mid sections having mixed/estuarine properties (Figure 6-71).

Figure 6-71 Salinity map of property

The roadways were observed to generally have minimal culverting for forest connectivity and drainage. An ideal example of the lack of forest connectivity may be found at the southwestern-most access road. This marl rubble road showed an extreme segregation of fresh and tidal saline waters, as a result of a 2m wide road (Plate 6-61).

The present surveys were conducted during a period of very rainy conditions. Previous salinity data collected in 2013 showed greater amounts of mixing in the southern sections, indicating an exchange of waters through or below the existing roadway.

Plate 6-61 Segregation of fresh and saline/brackish water as a result of roadway Photo taken Nov 2019 showing salinity difference along Western access road

The water level logger placed in the south-west mangrove forest system (Figure 6-72) showed a gradual decline in water level over a week, indicating slow release of accumulated fresh water from the site. There were small peaks between 10-11am daily, indicating a small tidal influence. The mean water level showed fluctuation of approximately 6cm over the normal standing water level observed.

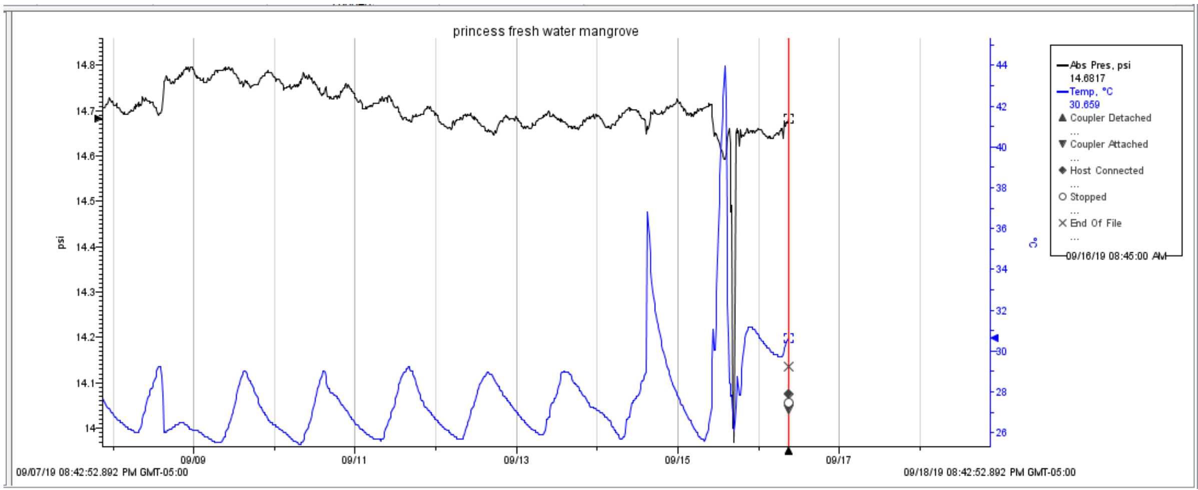


Figure 6-72 Water level logger result for SW mangrove stand

Figure 6-73 below illustrates the visible hydrology flows encountered during the field investigations in the northwestern red mangrove area. A key feature of the forest, which was likely created by previous reclamation work, is the occurrence of hydrology barriers found at the northern-most areas of freshwater gradients. Transect 7 area is experiencing saltwater stagnation and a slight rise in salinity and may be as a result of previous reclamation activity along the Western edge. This segment showed evidence of strong tidal influence but with a disturbed hydrology disallowing tidal waters from retreating completely.

However, at the eastern sections of that forest, a clear tidal influence was documented on the NE side of the property, within the stand of Red mangroves. A calculation of the difference in water height between peaks and lows result in a 0.17 PSI difference on some days. This equates to a 12 cm diurnal difference in water height recorded at the eastern extreme of this mangrove section, found over 300m away from the coastline.

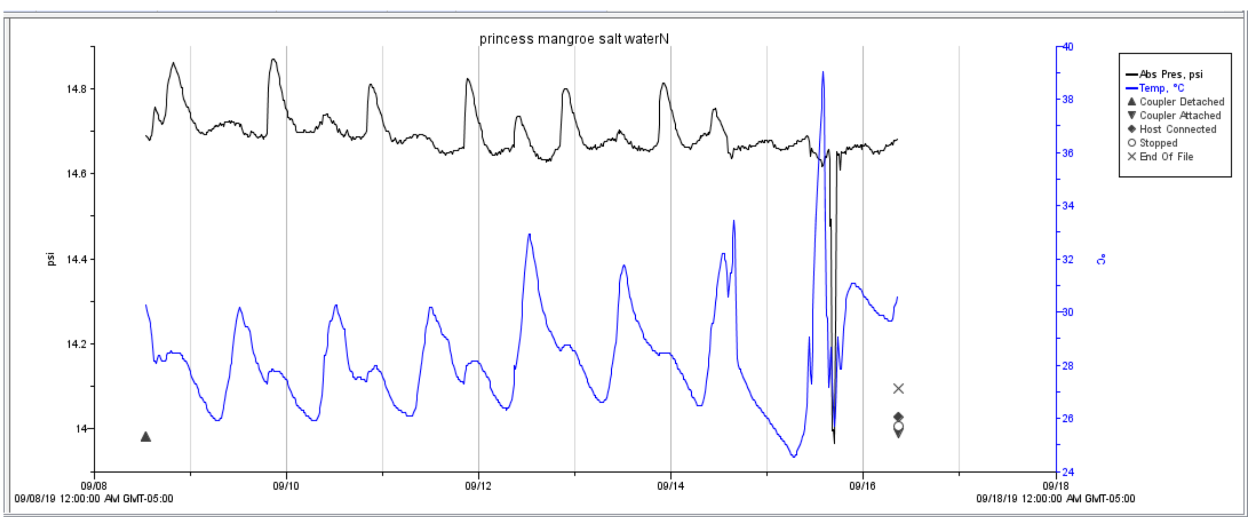


Figure 6-73 Water level logger results for NW red mangrove stand near access road

Figure 6-74 illustrates that freshwater flow is prevented from travelling further north to the sea near Transect 6, creating an extensive freshwater collection basin. Wetland birds such as the West Indian Whistling duck was observed in this “floodplain” area (Plate 6-45). However, this water eventually drains south to Transect 3 area when maximum capacity is reached (Figure 6-74). This flow was observed during heavy rains during a field visit. The northern floodplain area has no mangrove species present. The mangrove tree line begins over 100m South of wetland extent. This area has a water depth of 0.15 m and salinity was 2 ppt.

Another area of freshwater obstruction was observed along the service road mangroves (south of Transect 8 and proposed main pool #2). Three roads intersect in this area, with no visible culvert (culvert is 40m south). This area shows a degraded mangrove forest (4 acres), with signs of recovery (Plate 6-62).

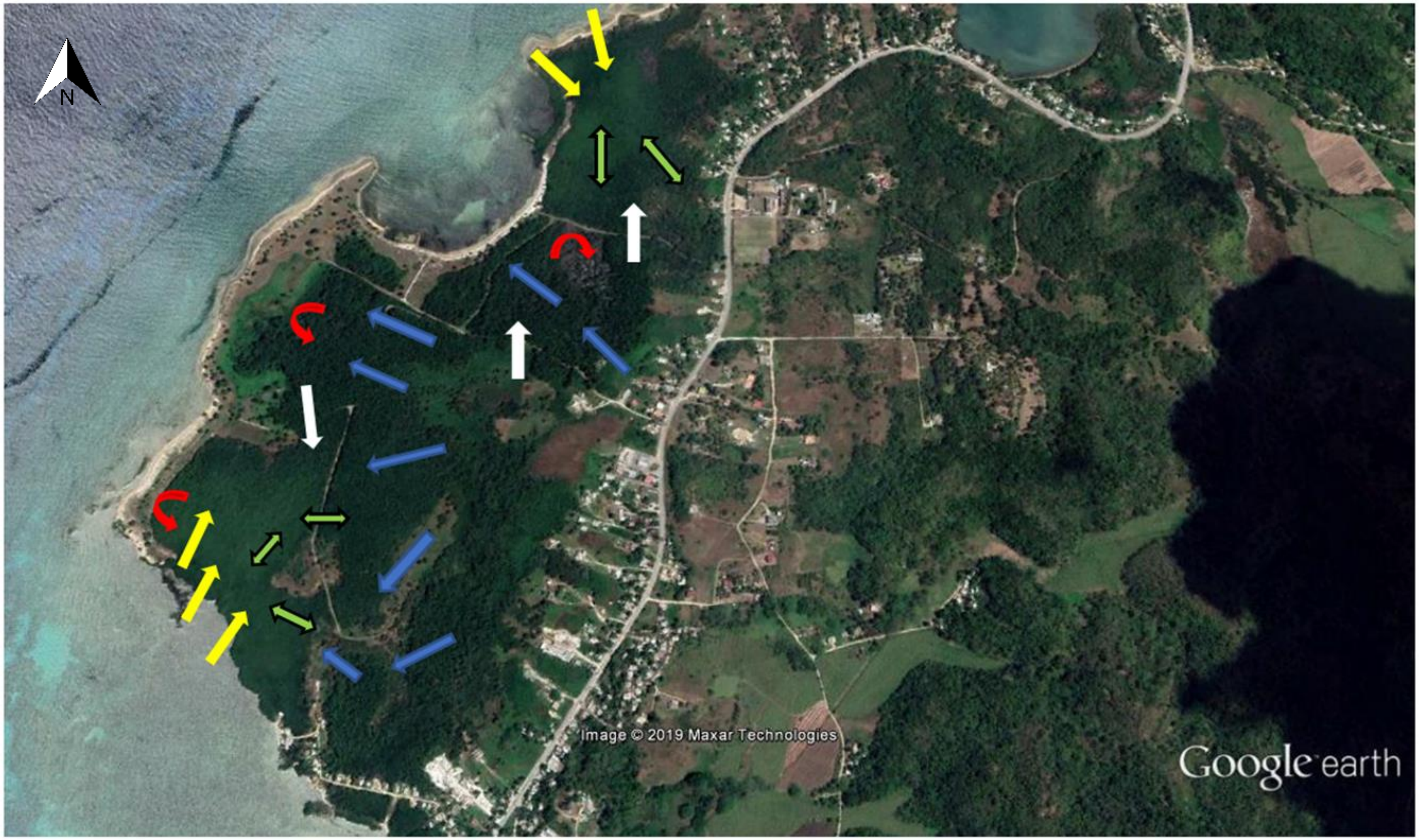


Figure 6-74 Observed wetland hydrology regime

(Blue arrows (freshwater flows), Yellow arrows (tidal/sea water flows), green arrows with double points (brackish/mixing conditions), White arrows (culverts or active surface flows; fresh water), Red curved arrows (barrier to flow/settlement/stagnation points)

Plate 6-62 Section of degraded mangrove area with significant standing fresh water

Near Transect 4, water level logger data revealed a 10.8 cm difference in tidal fluctuation on a given day. There were peaks of tidal waters between 8 pm and 9 pm daily, with lower tidal intake levels between 9:30am-11am daily. This suggests evidence that the mid-section of the mangrove is tidally influenced, despite not showing a thorough mixing of waters.

A key hydrological feature of the northeastern mangrove forest is a tidal creek observed on the northeastern tip of the property boundary near Transect 9 (Figure 6-75, Plate 6-63). Tidal waters were observed to enter and leave the northeastern mangrove system through this point.

Prior to 2003, the area was likely wetted by normal surface tidal movements. The creek was observed to form post reclamation works (2016), leading from highway drainage culverts adjacent to the Green Island High School.

Figure 6-75 Creek leading from culverts adjacent to Green Island High School

Plate 6-63 Active tidal creek adjacent to Transect 9

6.3.2.4 Flora (non-mangrove)

Besides mangroves, the property had forty-five (45) observed species of terrestrial plants or wetland-associated species. These are listed in Table 6-41 below along with their abundance based on the DAFOR scale and conservation status based on the International Union for Conservation of Nature (IUCN) red list.

There exists an area of open grassland adjacent to the coastline (Plate 6-64) as well as a few inland patches of secondary woodland consisting of trees, vines and shrubs. The open grassland adjacent to the coastline, is dominated by grasses with some shrubs and sparsely vegetated by trees such as the West Indian almond (*Terminalia catappa*) and Guango (*Samanea saman*) (Table 6-41).

Plate 6-64 Grassland adjacent to coastline consisting of grasses and some trees

Table 6-41 List of non-mangrove flora observed throughout survey area along with their abundance

Flora Observed	**DAFOR Index**	**Growth Form**	**Conservation Status (IUCN Red List)**	**Occurrence**
Acacia sp.	F	Tree	Least Concern	Native
Acrostichum aureum (Mangrove Fern)	A		Least Concern	Invasive
Bidens pilosa (Spanish needle)	A	Herb	Least Concern	Invasive
Blighia sapida (Ackee)	R	Tree	Least Concern	Invasive/Relict
Bromeliads (various)	F		Least Concern	Endemic & or Native
Bursera simaruba (Tourist tree)	R	Tree	Least Concern	Native
Butea monosperma (Flame of the Forest*)*	O	Tree	Least Concern	Check ID (Invasive)
Bumelia salicifolia (white bullet)	R	Shrub/Tree	Least Concern	Native
Canavalia sp.	O	Shrub	Least Concern	Unknown
Cecropia peltata (Trumpet Tree)	O	Tree	Least Concern	Invasive
Cissus sicyoides	R	Climber/twiner	Least Concern	Native
Clitoria sp.	O	Vines/climber	Least Concern	Native
Cocos nucifera (Coconut)	F	Tree	Least Concern	Relict/Cultivated
Dalbergia sp. (Coin vine*)*	A	Vines/climber		Native
Delonix regia (Poinciana)	R	Tree	Least Concern	Invasive
Guazuma ulmifolia (Baceda /Bastard cedar)	R	Tree	Least Concern	Native
Haematoxylum campechianum (Logwood)	A	Tree	Least Concern	Naturalized
Hibiscus tiliaceus (beach hibiscus)	O	Shrub/Tree	Least Concern	Native
Hohenbergia sp.	F	Epiphyte	Endangered	Endemic
Ipomoea pes-caprae	O	Climber/Twiner	Least Concern	Native
Lantana sp. (wild sage)	R	Shrub	Least Concern	Native
Leucaena sp. (Lead tree*)*	F	Shrub/tree	Least Concern	Invasive
Mangifera indica (Mango)	R	Tree	Least Concern	Relict/Cultivated
Megathyrsus sp. (Guinea grass*)*	A	Grass	Least Concern	Naturalized

Flora Observed	DAFOR Index	Growth Form	Conservation Status (IUCN Red List)	Occurrence
*Mimosa pudica (*Shame ole lady*)*	A		Least Concern	Native
Morinda citrifolia (Noni*)*	F	Tree	Least Concern	Naturalized
Musa sp. (Banana tree)	F	Tree	Least Concern	Relict/Cultivated
Orchid (*Broughtonia nigrilensis)*	R		Endangered	Endemic
Samanea saman (Guango)	R	Tree	Least Concern	Naturalized
Sedge Grass (*Carex sp.)*	F		Least Concern	Native
Sesuvium portulacastrum (Sea purslane)	R	Twiner	Least Concern	Native
Sida acuta (broom weed)	O	Shrub	Least Concern	Native
*Solanum erianthum (*Wild susumba*)*	R	Shrub	Least Concern	Native
Solanum torvum (Susumba)	R	Shrub	Least Concern	Native
Spartina sp. (Saltgrass cordgrass*)*	O		Least Concern	Naturalized
Sphagneticola trilobata (Creeping Daisy/Wedelia)	F	Shrubby herb	Least Concern	Native
Sporobolus sp.	F		Least Concern	Native
Terminalia catappa (Almond)	O	Tree	Least Concern	Cultivated/Naturalized
Themeda arguens (Christmas grass)	R	Grass	Least Concern	Invasive
Thespesia populnea (Seaside Mahoe)		Tree	Least Concern	Native
Trichostigma octandrum (hoop vine)	R	Vine	Least Concern	Native
Tridax procumbens (Tridax daisy)	R	Herb	Least Concern	Invasive
Typha sp. (Reed grass*)*	F	Herb	Least Concern	Native
Urechites lutea (Nightshade)	R	Climber	Least Concern	Native

DAFOR occurrence rank: Usually a subjective scale of species occurrence within an area of study. The acronym refers to, Dominant, Abundant, Frequent, Occasional, Rare.

6.3.2.5 Surrounding Community External Impact

Though the majority of the proposed wetland impact area is not directly impacted by the community, numerous houses and businesses were observed at the eastern and southeastern periphery of the wetland. These small dwellings, including a hardware store and a concrete batching plant are upland from the wetland, with drainage in a net northern direction. The wetland will likely filter sediment and sewage from these sources. It may also be assumed that these residential dwellings have soakaway pits discharging into the groundwater in the vicinity of the wetland. Plate 6-65 shows a very visible and poorly placed soakaway pit under construction along the main road, west of the proposed hotel property. This cistern showed a matching water level to sea level. This possible contamination is further evidenced by the water quality results (Section 6.1.11.2) in two areas within the mangrove forest, which show that there is a high level of faecal coliform and *Enterococcus sp.* bacteria present. Residences on the hillside with soakaway pits may also affect groundwater as contaminants would flow northwest toward the proposed project site.

Plate 6-65 Soakaway pit under construction at a property west of proposed hotel project property

6.3.3 Summary

Based on satellite and physical evidence, the site was historically a brackish mangrove forest, influenced by tidal waters from the east and West, mixing with freshwater flows originating from the South (along the highway). The tree heights, health and structure indicate that the area was a brackish forest, providing an ideal mix of land-based sediment and nutrients and other nutrients from seawater. The previous reclamation and access road works that occurred on the property, have minimally changed the hydrology of the site. These hydrological changes have resulted in mostly small scale and undetectable effects in the forest, as most sections still show mixing of waters, though at a slower rate. Though the majority of degraded mangrove forest areas are as a result of dumping, some sections of the forest have been damaged and degraded indirectly by the stagnation of freshwater flow (area south of Transect 21).

The southwestern fringes (by Transect 7) are also displaying signs of stagnation and resulting hyper-salinity (also evident in salinity recorded), displaying short trees with smaller leaves. This section may provide the least ecological services of the entire forest as the canopy is very enclosed and will have lower leaf and fruit productivity, lower levels of carbon sequestration, minimal migration routes/paths for fish and does not attain much height and dimension to serve as a bird habitat.

6.3.4 Ecosystems and Habitats

The proposed project area occurs within a Coastal Ecosystem with a combination of marine, wetland and terrestrial habitats. Each of these habitats has varying degrees of complexity and diversity. Habitat functions and extent vary spatially and temporally. The two major zones identified in the project area include a Terrestrial Habitat (Figure 6-76) and a Marine Habitat (Figure 6-77).

Terrestrial Habitats;

- Wetland and Mangrove Forest Habitat
- Beach and Dune Habitat
- Transition Zone
- Disturbed Area/Habitat

Marine Habitats; Lagoon and Reef Areas

- Reef Habitat
- Fringing Reef Habitat
- Shallow Reef Habitat
- Pavement Habitat
- Seagrass Habitat
- Intertidal Habitat
- Mud/Silt/Sand

Descriptions of each sub-habitat are outlined below:

Wetland and Mangrove Forest Habitat

The project area has an extensive wetland and mangrove forest which have varying community structure and zonation, spatial and temporal variations along with varying degrees of human modification and influences. That is; Areas with mature trees to areas with shrubs and grasses; Areas with varying species composition such as areas dominated by Red Mangroves, Black Mangroves, White Mangroves and varying combinations of these species; Areas with varying salinity, (saline to brackish and fresh water);

Areas with varying hydrological regime these may range from temporary ponding areas to permanent water bodies estuaries or coastlines; Areas with varying levels of disturbance (fragmentation, deforestation and other anthropogenic influences) to areas which are more isolated and pristine. These varying conditions give rise to diverse habitats within the forest and wetland.

Beach and Dune Habitat

Beaches and dunes occur along the sea land interface, forming unique habitats. The beaches along the Negro Bay lagoon have been modified and the dune areas pruned while other beach and dune areas are less modified.

Transition Zones

Transition zones can be found throughout the project area between distinct habitats but can also be seen in areas of disturbance resulting in habitat fragmentation and edge effects.

Disturbed Area/Habitat

Disturbed areas range from deforested areas with limited vegetation (small shrubs and grasses), roadways, dumped areas and other modifications. Anthropogenic activities include, farming, logging, hunting and access ways.

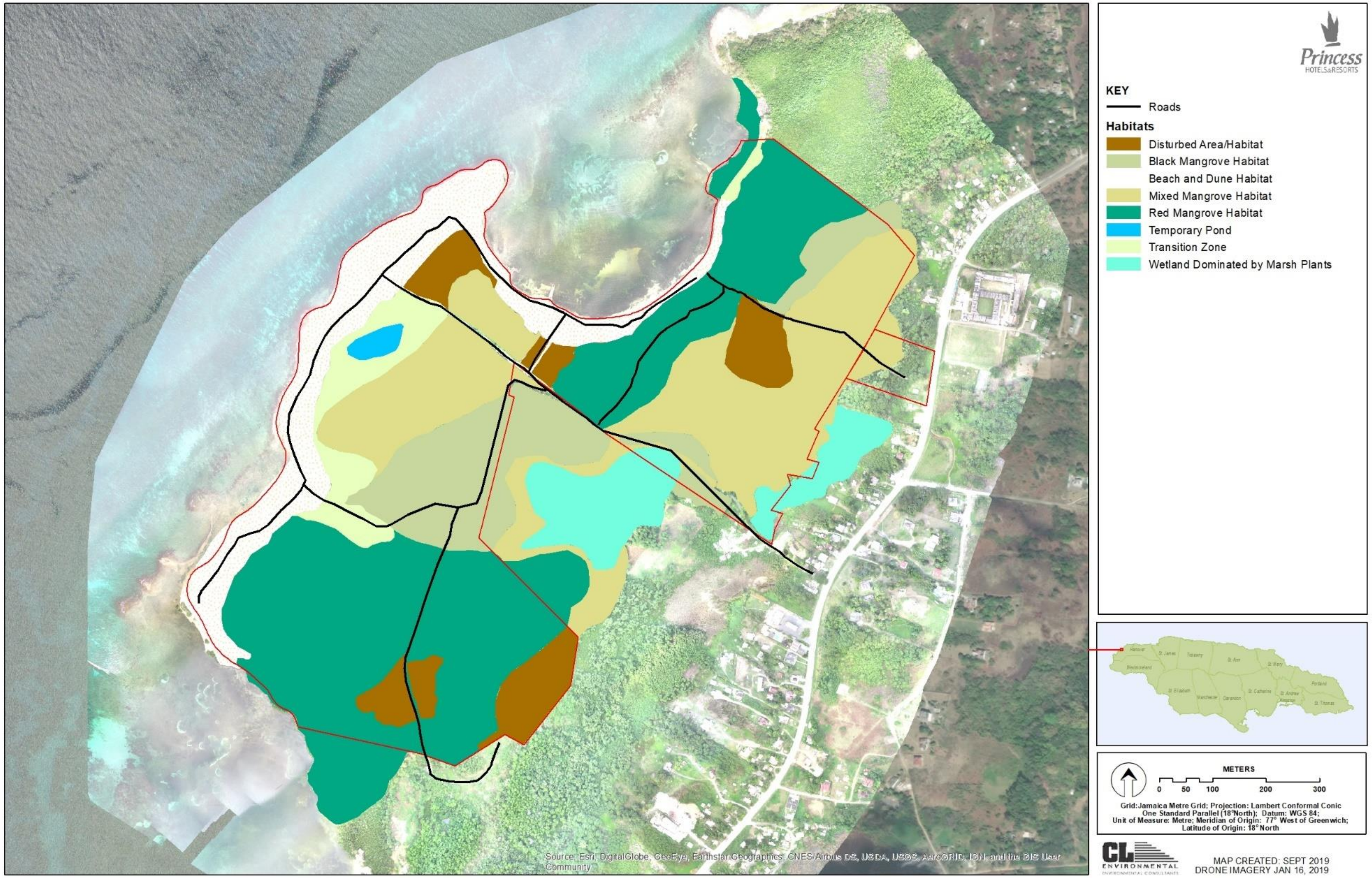


Figure 6-76 Terrestrial Habitats Map

Reef Habitat

Reef habitat areas are deeper sections of an extensive reef system with well-defined spur and grove formations. These sections of the reef have high levels of density, diversity and complexity. Heading landward the relief decreases and transitions to fringing reef and pavement habitats.

Fringing Reef Habitat

The fringing reef is extremely shallow with sections that are periodically exposed. There is an extremely limited benthic community, including small coral colonies, sparse and short seagrass, macro and turf algae.

Shallow Reef Habitat

Shallow reef areas are found as transition areas between fringing reefs and the deeper reef areas. And between pavement areas and deeper reef area. The coral community here has low relief (small spur and groove) and patch reefs.

Pavement Habitat

Pavement habitats in the project area are widespread and range from sparse areas to areas with patchy density and diversity of seagrass and or small encrusting species (including hard corals) to areas with larger patch reef, larger coral colonies. The project area has sections of pavement densely populated with rock boring urchins so macro and turf algae.

Seagrass Habitat

The proposed project has extensive seagrass beds which are not uniformed in density, species composition, substrate type, colonization and function. Sections of the bed may be dense with long healthy blades or sections maybe very sparse with short blade discoloured blades.

Intertidal Habitat

Sections along the nearshore of the project area are composed of a rocky shore with typical intertidal zonation while other intertidal habitats are also found along the seawall and groyne areas (artificial substrate). Zonation along the rocky shore is more extensive than on the rocks. Diversity in these areas tend to be limited, however represent a unique habitat in the area.

Mud/Silt/Sand

The main bay in the project areas has sections which are composed of mud, silt and sand. Muddy and silty areas sloe have deposition of marine debris particularly dead grass and algae. Sandy areas are found also found in both deep and shallow sections of the bay. Species density and diversity is extremely limited.

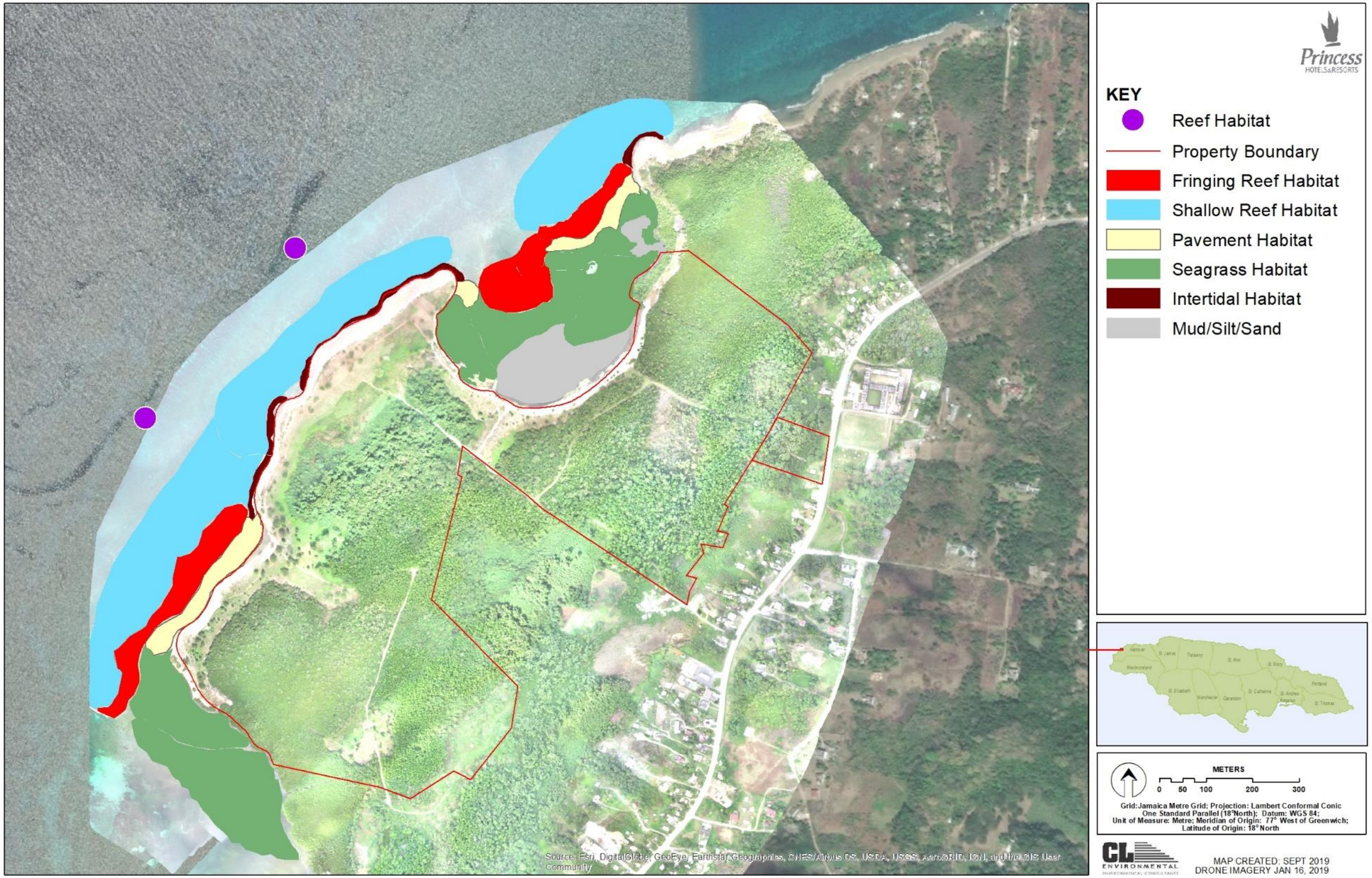


Figure 6-77 Marine Habitats Map

6.4 NATURAL HAZARDS

6.4.1 Earthquakes

Jamaica straddles the boundary between Caribbean tectonic plate and Gonave micro-plate. The Walton and the Enriquillo Fault Zones, extending respectively to the west and the east of Jamaica, form the boundary between these two plates (Figure 6-78). The movement across these two fault zones are transmitted through the Jamaican Fault systems and are the source of significant earthquake activity in the island. The nearest active fault zones are the Maryland fault zone and the Fat Hog Quarters fault zone. Both are East-West trending left-lateral strike slip faults. The Maryland Fault zone is located about 500m south of the property boundary and intersects the coastline at Green Island Harbour, while the Fat Hog Quarters fault zone (fgq), located approximately 3km north of the project area is and traverses the coast near Cousins Cove.

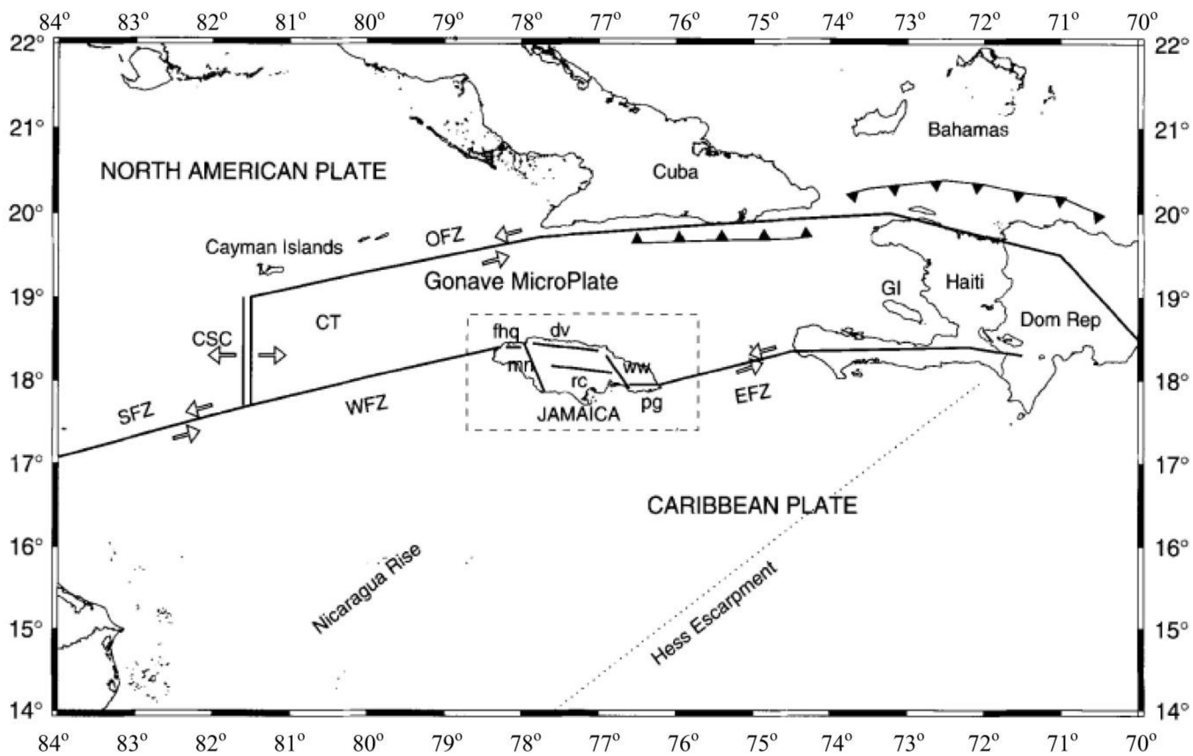


Figure 6-78 Jamaica region tectonics: SFZ: Swan fracture zone; CSC: Cayman Spreading Centre; CT: Cayman Trench; OFZ: Oriente fault zone; WWF: Walton fault zone; EFZ: Enriquillo fault zone; GI: Gonave Island; fhq: Fat hog quarters fault; dv: Duanvale fault; ww: Wagwater fault; pg: Plantain garden fault; mn: Montepelier-Newmarket fault zone; rc: Rio Minho-Crawle river fault (source: (Wiggins-Grandison M. , 2001).

Figure 6-79 show the geographical distribution of the earthquake epicentres between of 1977 and 2014 as well their magnitude in reference to the location of the proposed development and Figure 6-80 presents the distribution of the number of earthquakes per 100Y with intensities of modified Mercalli VI or greater between 1880 to 1960 and the main active fault systems in Jamaica. Both figures clearly indicate that the earthquake activity of the Green Island area is significantly lower than in the east of Jamaica. Although the region near the development has about lowest earthquake risk in Jamaica, the earthquake risk exposure of the Western region of Jamaica is still significant and the close proximity to Maryland and Fat Hog Quarters fault zone cannot be ignored.

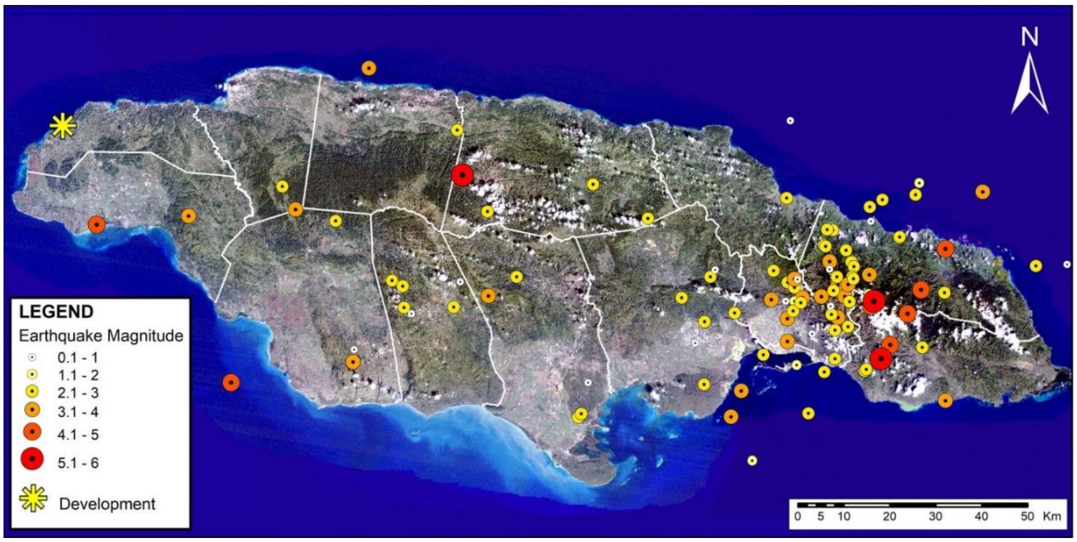


Figure 6-79 Earthquakes in Jamaica 1977-2014 (Source: earthquake.usgs.gov Earthquake Archive)

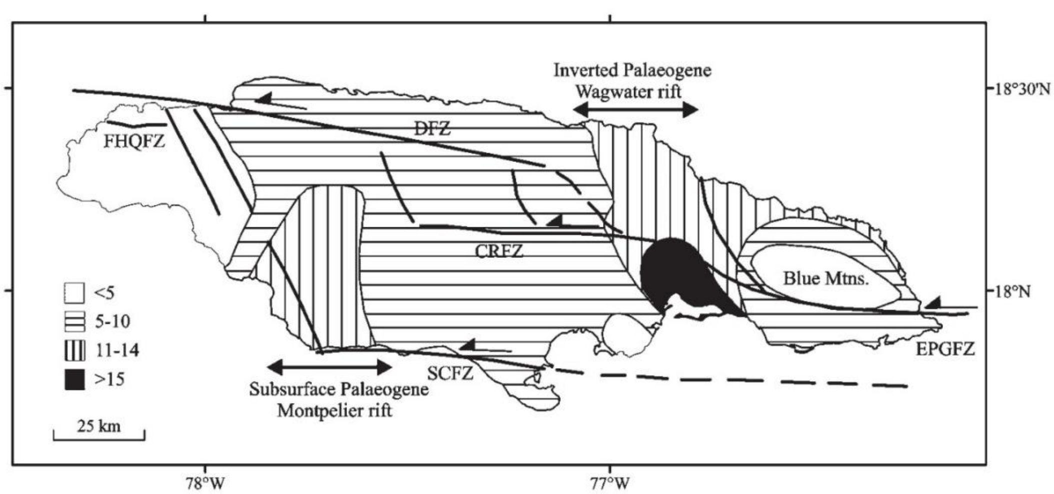


Figure 6-80 Geographical distribution of the number of earthquakes per 100Y with intensities of modified Mercalli VI or greater between 1880 and1960 (modified from Shepherd & Aspinall 1980). (FHQFZ: Fat Hog Quarters fault zone, DFZ: Duanvale fault zones SCFZ: South Coast fault zone, CRFZ: Crawle River fault zone, EPGFZ: Enriquillo-Plantain Garden fault zone) (Source: (Wiggins-Grandison C. D., 2007)

The Probabilistic Seismic Hazard Assessment of Jamaica by (W. Salazar, 2013) based on updated earthquake catalogue for Jamaica covering the period 1551-2010 provides design estimates for Peak Ground Acceleration (PGA) for a 475-year Return Period of and Spectral Acceleration (SA) for structural periods of 0.2s (S_S) and 1s (S_1) and 5% damping for a 2475-year and 4975-year Return Period. Peak ground acceleration (PGA) is the maximum horizontally acceleration (or rate of change of speed) that the ground is subjected to by an earthquake. Spectral Acceleration is the maximum horizontally acceleration that an object (i.e. a building) will experience by a seismic wave of a specific period. The Spectral Acceleration (SA) is the preferred Seismic Hazard intensity parameter used in most modern building code including the International Building Code 2012. The oscillator period is chosen to match the fundamental period of the structure; the short period 0.2 sec corresponds with low buildings that are a few floors tall and the long period of 1.0 sec is used for tall buildings with more than 7 floors. The range of the Peak Ground Acceleration and Spectral Accelerations extrapolated for the Green Island area from the seismic hazard maps in (W. Salazar, 2013) are summarized in **Error! Reference source not found.**. For the Green Island the estimate Peak Ground Acceleration & Spectral Accelerations can be assumed to be at the lower end of tabled ranges. It should be noted that these parameters are in reference to solid rock conditions only and do not take in account the amplification that can be caused by poor local soil conditions.

Table 6-42 Estimated Peak Ground Acceleration & Spectral Accelerations for Green Island

Return Period	Parameter		
	PGA	S_S (0.2s SA)	S_1 (1.0s SA)
475 Year	0.173-0.191g	-	-
2,475 Year	-	0.794-0.868g	0.230-0.255 g
4,975 Year	-	1.028-1.116g	0.282-0.314g

Based on SPT-N blow counts and the soil condition encountered in the boreholes, the geotechnical consultant Horizon Construction Jamaica Limited assigned the proposed development site a Site Classification of F: Soft Soils. Table 6-43 list the seismic and site class parameters summarized by the Horizon Construction Jamaica Ltd for a probability of exceedance of 10% in 50 Year, the equivalent of 475 Year Return Period. Fa and Fv are the site amplification factors respectively for a spectral acceleration (SA) of 0.2 sec and 1.0 sec.

Table 6-43 Seismic and Site Class Parameters

Return Period	Parameters					
	PGA	S_S (0.2s SA)	S_1 (1.0s SA)	Site Class	Fa (0.2s SA)	Fv (1.0s SA)
475 Year	0.15g	0.42	0.17	F	1.7	3.2

While the risk that this site will be affected by a major earthquake is not particular high, the poor subsoil conditions will result in significant amplification and increase of the destructive impact of an otherwise relative weak earthquake. Much of the loss foundation bearing capacity, loss of axial and lateral resistance within the liquefied zone and post-earthquake settlement can be mitigated by the soil improvement works and the foundation designs recommended in the section about the geological and geotechnical conditions of the site.

6.4.2 Hurricanes

The Caribbean region is vulnerable to tropical storms and hurricanes each year from June to November. During the hurricane season (June to November) low-pressure cyclonic systems form off the African coast between latitudes 5 to 25 N and travel north-westerly towards the Caribbean Basin gradually increasing in intensity if ocean conditions are conducive.

Dramatic and abrupt changes to the coastline can occur because of these storms. In general, coastal protection structures are designed to withstand wave attack from these extreme storm events (e.g. the selection of an armour stone size that would be required for a coastal structure or the determination of design wave forces that may occur because of extreme waves). Extreme waves occur infrequently, and decades or centuries of data must be explored to adequately describe the statistics.

For the Atlantic Ocean, detailed information on tropical cyclones, including all hurricanes, has been collected by the US National Oceanic and Atmospheric Administration (NOAA), specifically at the National Hurricane Centre (NHC). This database of storm tracks and other parameters was the main source of information describing individual storms. Hurricane tracks in the North Atlantic basin can often be characterized by a parabolic sweep. These typically form between latitudes 5°N and 25°N off the west coast of Africa and then track across the Atlantic Ocean. Those formed at the lower latitudes are usually pushed on a westerly track by the north-east Trade Winds, whereas those of the higher latitudes track more to the north and north-west.

A tropical cyclone is classified as a hurricane only after it has attained one-minute maximum sustained near-surface (10m above ground level) winds of 33m/s or more. Below this, these cyclones are referred to as tropical storms. The Saffir-Simpson Scale is commonly used to classify hurricanes into five different ranges based on the maximum wind speed attained, with a Category One having the lowest wind speeds, and the Category Five with the highest. Although the category of the hurricane indicates its intensity and its damage potential, the impact of the hurricane depends on the location of the eye of the storm relative to the site. The intensity and frequency of storms vary with various global meteorological conditions from year to year, and it is suggested that it may be influenced by phenomena such as El Nino/La Nina and mid-Atlantic sea surface temperatures. Cyclonic systems move in a north-westerly direction, with most of the systems tracking south of the island, which could have devastating impacts on the western shorelines of the island.

6.4.2.1 Storm Occurrence

Using HurWAVE (Banton, 2002), an in-house hindcasting program, it was determined that a total of **118 hurricanes and tropical storms** have passed within a 300km radius of the Princess Resorts property since 1850. The number of occurrences within each storm category (per the Saffir-Simpson scale) is shown in Figure 6-81. The bar chart shows that many of the storms that pass the project area are weaker than a Category 3 cyclone. Only four (4.2%) of the recorded storms were Category 3 or stronger. The graph shows that the study area was more frequently hit by tropical storms and was rarely affected by major hurricanes. Figure 6-82 shows the storm tracks of the hurricanes that came closest to the site, the most intense of which was Hurricane Gilbert (a Category 3 hurricane in 1988). The storm track data shows that the major hurricanes pass Jamaica (and by extension the site) along the south. It therefore holds that, based on the anticlockwise nature of hurricanes, the winds and waves experienced at the site will be from the east (Figure 6-83).

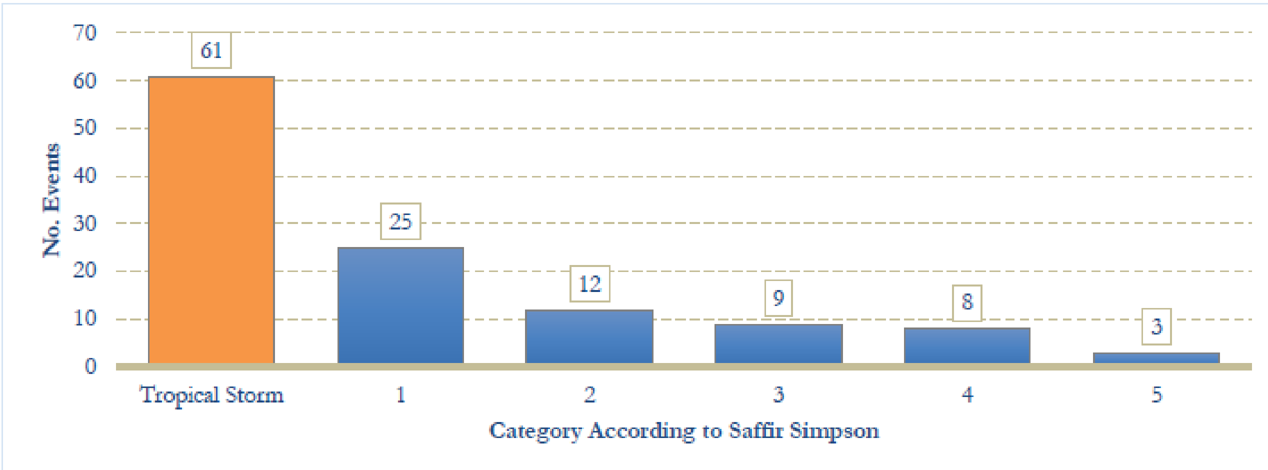
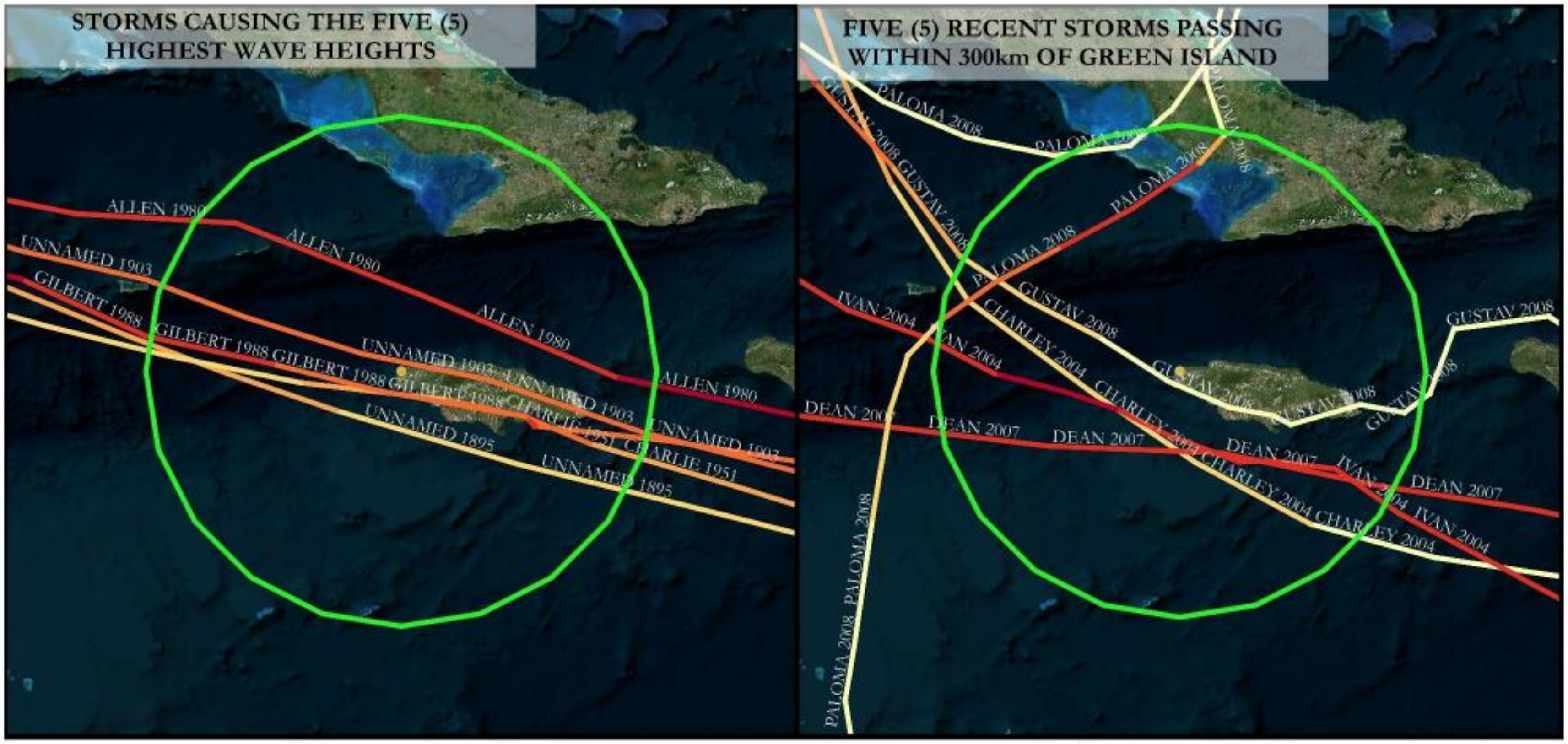


Figure 6-81 Distribution of storms according to the Saffir Simpson scale



Name	Season
UNNAMED	1895
UNNAMED	1903
CHARLIE	1951
ALLEN	1980
GILBERT	1988

Legend

- Hurricane Radius of Influence
- TROPICAL DEPRESSION OR TROPICAL STORM
- CATEGORY 1 HURRICANE
- CATEGORY 2 HURRICANE
- CATEGORY 3 HURRICANE
- CATEGORY 4 HURRICANE
- CATEGORY 5 HURRICANE

Name	Season
CHARLEY	2004
IVAN	2004
DEAN	2007
GUSTAV	2008
PALOMA	2008

Figure 6-82 Storm tracks of the closest passing hurricanes

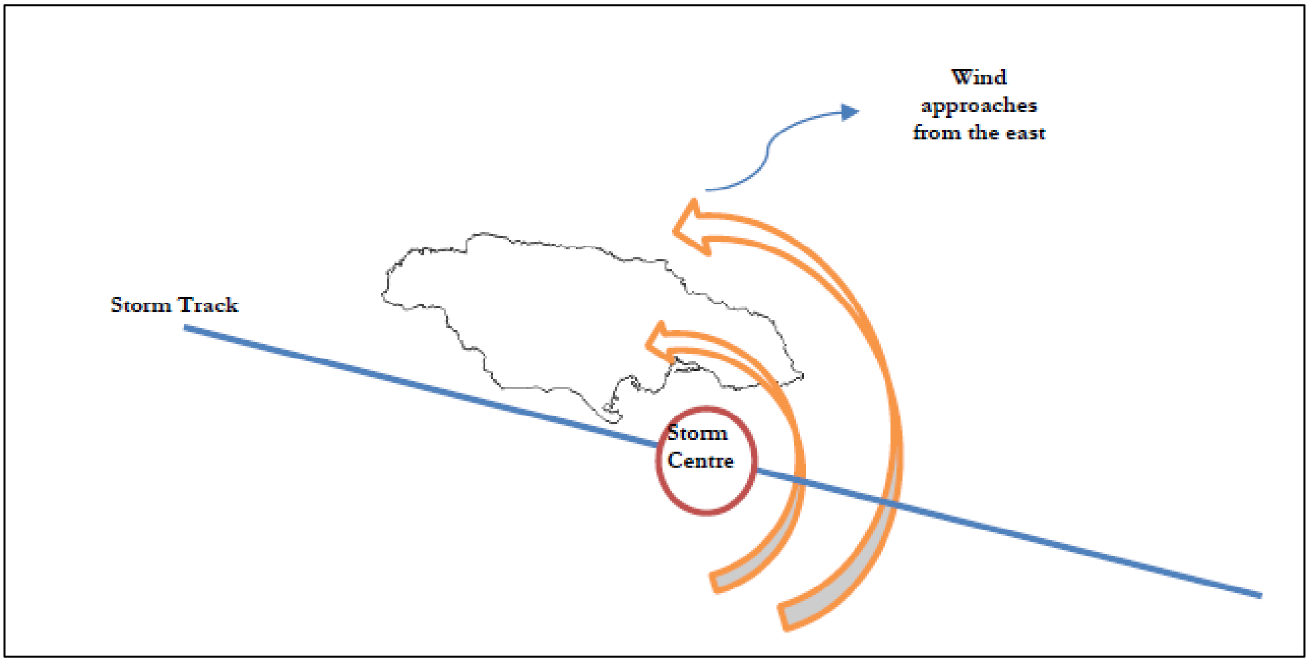


Figure 6-83 Schematic diagram showing wind and wave directions from hurricane conditions

6.4.3 Hurricane Waves and Storm Surge

6.4.3.1 Hindcasting Hurricane Waves and Surge Levels

Hurricanes have two immediate coastal hazards: (1) stronger waves and (2) higher water levels. These extreme conditions can be calculated using the MIKE21 Spectral Wave (SW)/Hydrodynamic (HD) models. The models can be forced with the highest deep-water wave and water level conditions and will simulate the transformation of waves from deep-water to the shallow water location of the site. It is important that the worst-case wave and water level conditions be used to simulate these shallow water conditions. For worst-case wave conditions, the values are selected through the process of hindcasting where conditions are calculated for a past event at a given time and location. Water levels are obtained by assessing the possible extreme tides and sea level rise conditions under hurricane conditions. The process is described briefly in the following paragraphs.

Deep water wave parameters were calculated for each selected tropical cyclone using parametric hurricane models (Cooper, 1988) (Burchell, 1996). The resulting wave conditions were divided into directional sectors and each set was fit to a statistical function (Weibull) describing their exceedance probability. The wave parameter values for the 50 and 100-year return periods were determined from the best-fit statistical distribution. The deep-water wave parameters corresponding to the 50 and 100-year return periods were computed for five directional sectors of incidence. These return periods were calculated using the probability of exceedance. The 1-in-25, 1-in-50 and 1-in-100- year events have, respectively, a 4%, 2% and 1% chance of occurring (Figure 6-84). The event with the 1% chance of occurrence is typically the design condition used for protecting residential buildings. Table 6-44 shows the wave heights, wind speeds, and periods for the directional sectors investigated. These wave parameters will be used in MIKE21 SW with the inclusion of the static storm surge levels to obtain design wave heights in the nearshore of the selected areas.

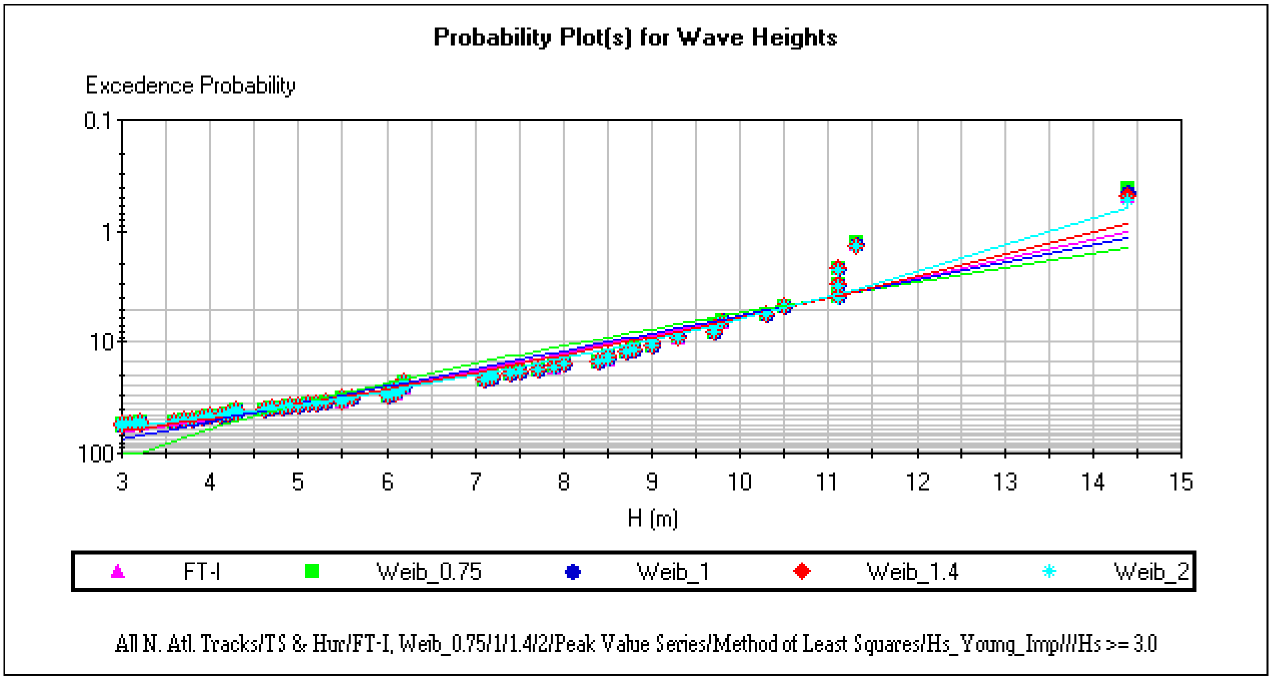


Figure 6-84 Probability of exceedance plots for significant wave heights

Table 6-44 Deep water hurricane wave parameters (significant wave height (Hs), peak period (Tp) and wind speed (Vm) resulting from the 25, 50 and 100-year return periods

Directional Sector	*Parameters*	*Return Period*		
		25	**50**	**100**
North	**Hs (m)**	6.11	7.77	9.28
	Tp (s)	10.33	12.0	13.43
	Vm (m/s)	25.68	29.99	33.94
North-east	**Hs (m)**	8.70	10.79	12.69
	Tp (s)	12.90	14.77	16.36
	Vm (m/s)	34.05	38.44	42.46
East	**Hs (m)**	10.00	11.78	13.41
	Tp (s)	14.08	15.61	16.94
	Vm (m/s)	31.54	35.48	39.09
West	**Hs (m)**	5.78	7.09	8.28
	Tp (s)	9.97	11.33	12.50
	Vm (m/s)	23.18	27.40	31.25
North-west	**Hs (m)**	5.83	7.31	8.66
	Tp (s)	10.02	11.55	12.86
	Vm (m/s)	20.54	24.60	28.88

The elevated water levels that accompany hurricanes can create flooding and cause damage to coastal infrastructure is known as storm surge. Storm surge is the rise in water surface elevation of the
sea above its mean level. Storm surge is made up of two major components:

1) Static surge, which includes:
   - Highest Astronomical Tide (HAT)
   - Inverse Barometric Rise (IBR) (caused by low pressure under hurricanes)
   - Global Sea Level Rise (GSLR)

2) Dynamic surge, which includes:
   - Wind Set-up (when winds push water up onto the land),
   - Wave Set-up (caused by wave breaking)

To compute the total static storm surge level in deep water, global sea level rise (GSLR) for the projected year and the highest astronomical tide were added to the IBR values. The results for the 50 and 100 and 200-year surface level values are listed in Table 6-45. Results were further used as input boundary conditions to the MIKE21 Spectral Wave (SW) model.

The MIKE21 SW/HD can only calculate waves and static water levels. Therefore, the assessment at the site was done in two steps:

1) Deep water conditions were transitioned to the site using the MIKE21 model suites (see Section: *Results of Hurricane Simulations*)
2) Dynamic surge levels were then calculated using sBEACH (see Section: *Inundation Levels*)

Table 6-45 Calculation of water levels for the 25, 50 and 100 year hurricane return periods

Parameter	Return Period (years)			Notes
	25	50	100	
IBR (m)	0.26	0.32	0.37	Determined through statistical hind-casting analysis
Highest Astronomical Tide (m)		*0.25*		Determined through historical analysis
Rate of Sea Level Rise (mm/year)		*7.5*		RCP8.6 Scenario value from IPCC 2014 report (Edenhofer et al. 2015)
Design Time Horizon (years)	50	100	200	Design life of the structure
Design Deep Water Surface Level without Climate Change (m)	**0.51**	**0.56**	**0.62**	**Sum of IBR, Highest Astronomical Tide**
Design Deep Water Surface Level with Climate Change (m)	**0.70**	**0.94**	**1.37**	**Sum of IBR, Highest Astronomical Tide, and Sea Level for 50, 100 and 200 years.**

6.4.3.2 Results of Hurricane Simulations

The computed and deep-water wave heights and water levels were used as input boundary conditions to the MIKE21 Spectral Wave (SW) module, which was coupled with the MIKE21 Hydrodynamic (HD) module. The model incorporates constant wind speeds from each directional sector in both the wave and hydrodynamic modules. The results were determined for each direction and return period. The computed values at each location were then combined to determine the worst-case (or highest) values for all directions for each of the different return periods.

Hurricanes have the potential to cause flooding from storm surge as well as damage due to the high energy wave impacts. Storm surge levels as shown are related to the increase in sea level due to the low-pressure system caused by a hurricane. Under existing conditions, the site would flood by more than 1.5m of water in the 50-year hurricane event (Figure 6-85). The rocky shoreline of Hotels 2 and 3 is at the greatest risk to wave damage during a hurricane. The wave heights at this section of the development are greater than 2.5m (Figure 6-86). This has implications for the design of the revetment and groynes proposed for the area, as stronger waves will require larger structures to reduce the associated risks.

The reef system at Hotel 4 reduces the wave heights reaching the shoreline at this section of the property. Reinforcing the reef further could reduce the waves reaching the proposed sandy beach area. Similarly, at Hotel 1, wave heights are reduced by the reefs to between 1-1.5m. While the bay is somewhat sheltered, the stronger waves are towards its western end and hence the area for the proposed Sea Rooms will have some protection.

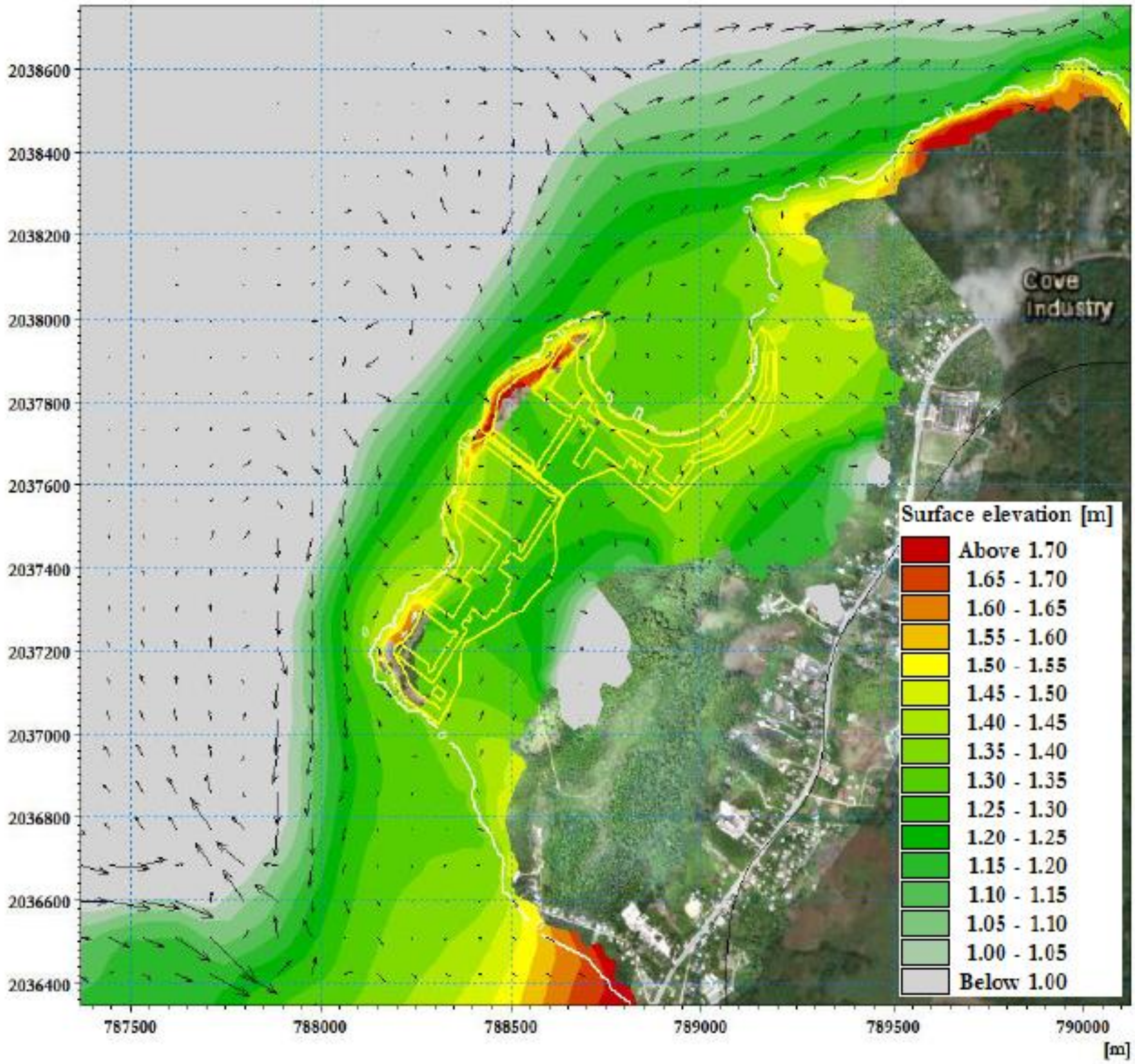


Figure 6-85 Static water level above MSL under the 1 in 50 year hurricane condition

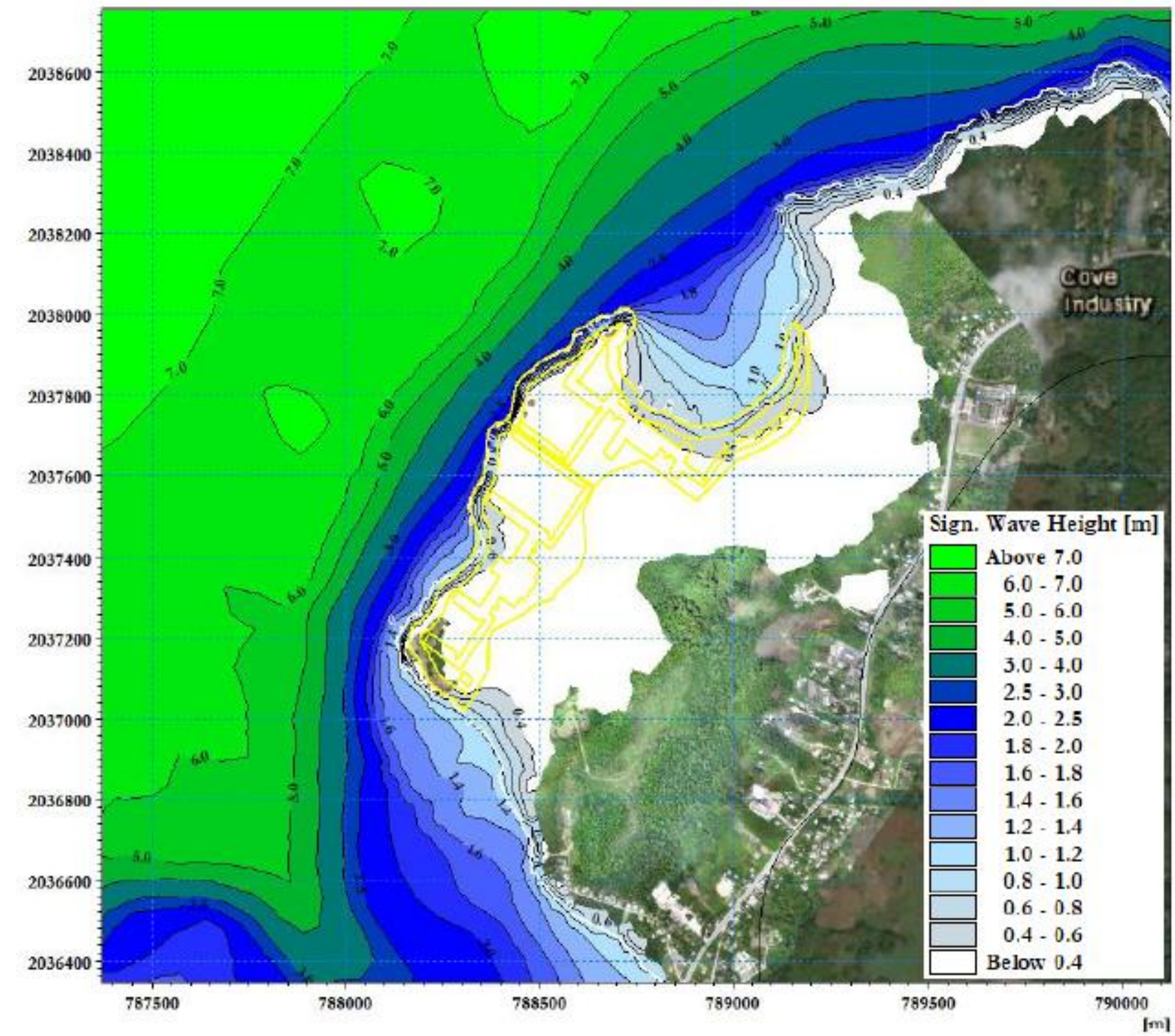


Figure 6-86 Significant wave heights under the 1 in 50-year hurricane condition

6.4.3.3 Inundation Levels

The numerical modelling presented in the following section presents wave run-up conditions for the existing shoreline. The storm surge calculated previously represents the static water level **(+1.3 – 1.7m MSL)** that will occur *close to* the shoreline. At the shoreline, however, waves run up onto the beach, which further increases the surge level. This component (wave run-up) is the dynamic component of storm surge that, when added to the static surge, gives the total inundation level.

The foregoing analyses provided the necessary design guidelines for the establishment of structure crest elevations and toe protection. These assessments were done in a two-step sequence (described below) by using the results from the sBEACH model as input to the online CRESS application.

sBEACH - The 1D sediment transport model and wave transformation model was used to model the cross-shore movement of sediments and expected shoreline changes (areas of high erosion or accretion potential) due to wave impact. The objective of using this model was to predict wave overtopping over any existing shoreline features along the project shoreline.

CRESS - The final inundation levels were computed by combining sBEACH results and the wave run-up/ overtopping over the existing shoreline features calculated from CRESS. CRESS is an online user interface that uses empirical coastal engineering equations. The application provides an approach to calculate wave run-up on either smooth-sloped linear beaches or rough sloped natural beaches, as well as wave runup and overtopping on rough and smooth sloped structures that are assumed to be impermeable.

Three representative cross-shore profiles were used as input to the sBEACH model. These profiles were extended perpendicularly from the shoreline to the 50m depth contour up to the project site. The wave heights and periods as well as the wind speeds and water level set-up from the 50-year storm event were extracted in 50m depths from the MIKE21 results, and input to the model with a direction perpendicular to the shore (representative of the worst-case scenario). Results were plotted for the 50- year return period after a typical 8-hour storm.

Table 6-46 gives the maximum values at the shoreline for wave heights and water levels. These values represent the boundary conditions and the guides for the design of the coastal structures. The values are indicative of the surging nature of waves in the area. Figure 6-87 - Figure 6-89 show surge levels at each of the hotel shorelines.

Table 6-46 Significant wave height, max water level an depth of scour at the shoreline for Profiles 1 - 3

Profiles	*Results from the 1 in 100yr storm*	
	Max Wave Height before Breaking	**Max Water Level**
Hotel 1	**1.6m**	**2.4m MSL**
Hotel 2 and 3	2.5m	2.7m MSL
Hotel 4	1.4m	2.4m MSL

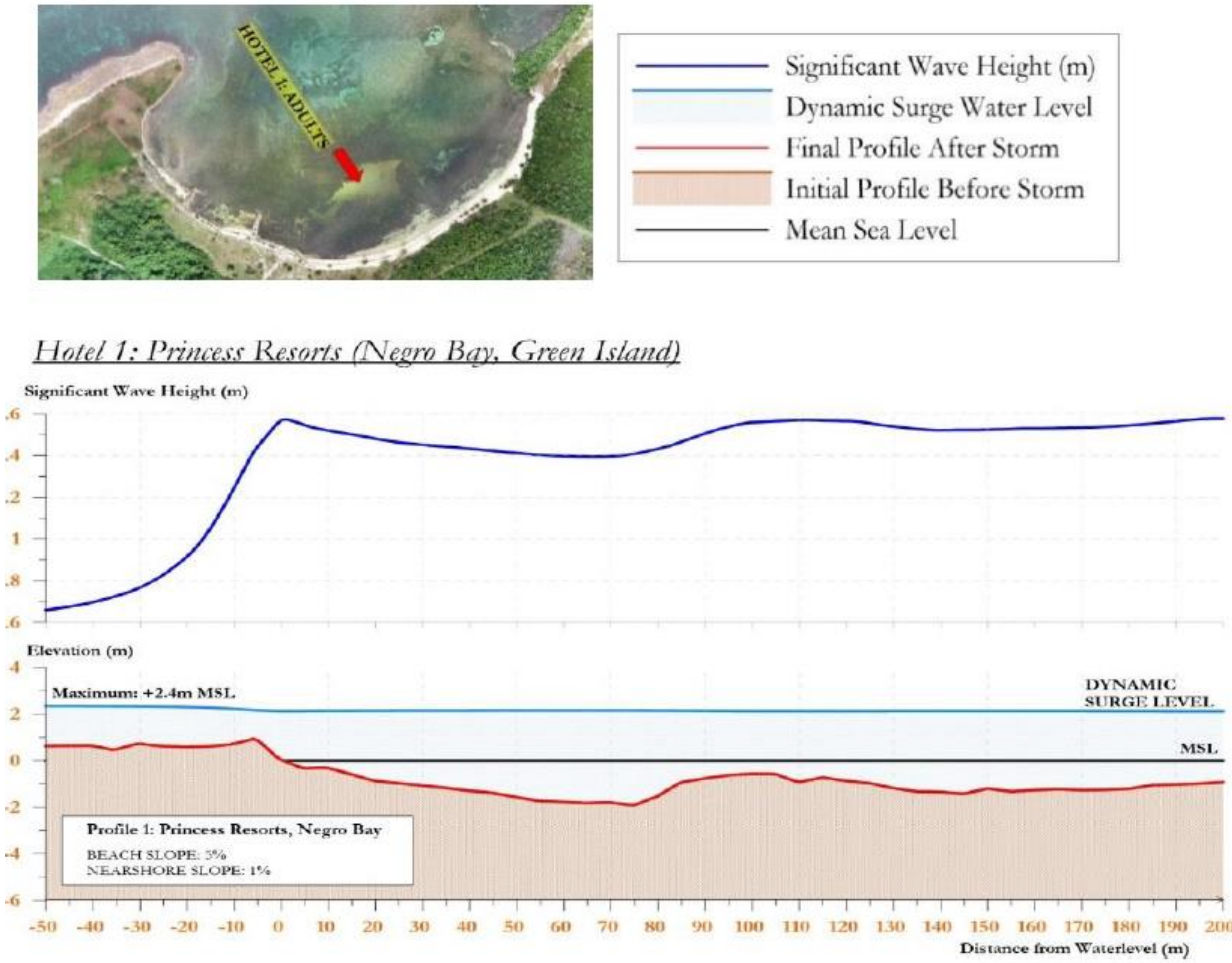


Figure 6-87 Surge levels for Hotel 1

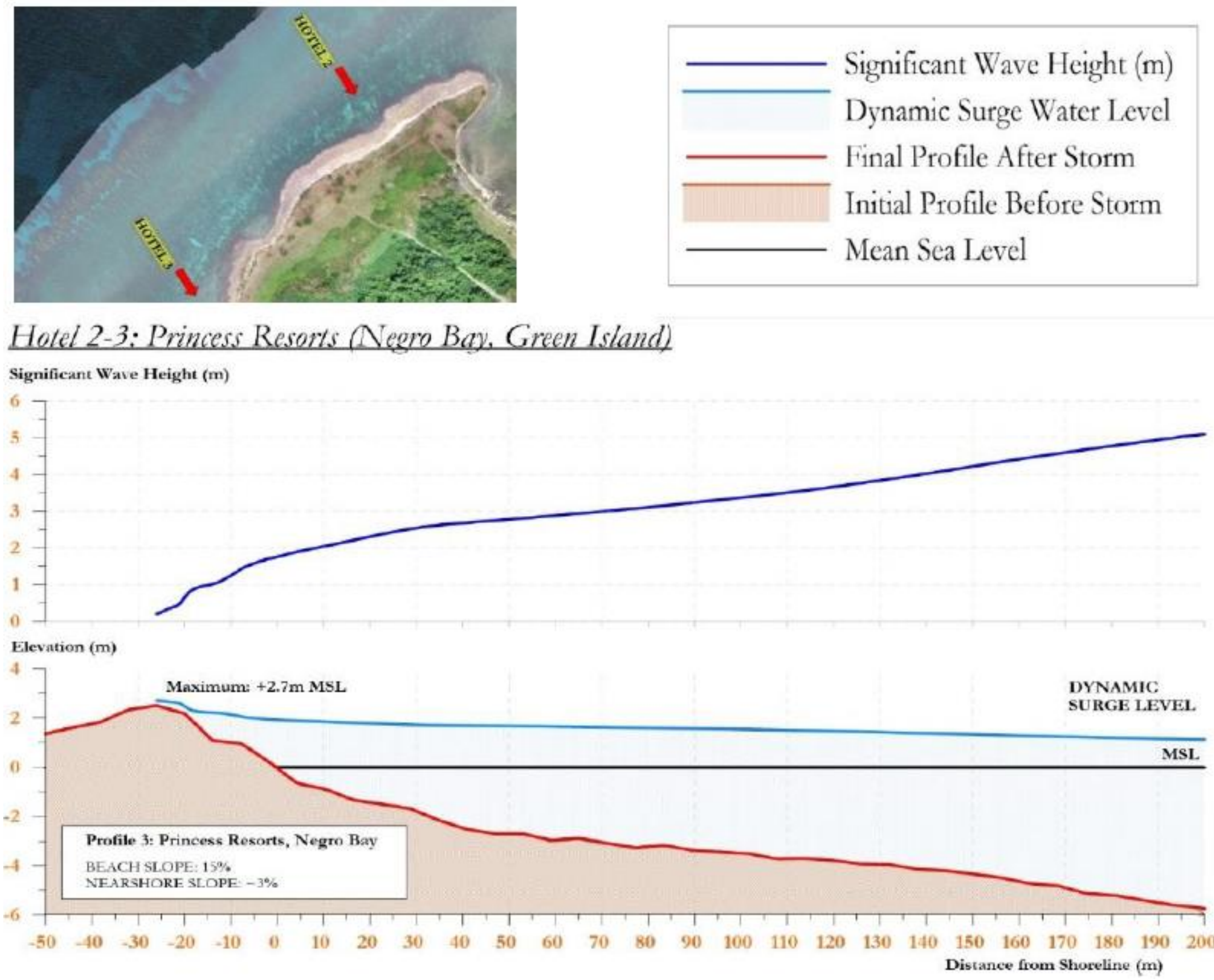


Figure 6-88 Surge levels for Hotels 2 and 3

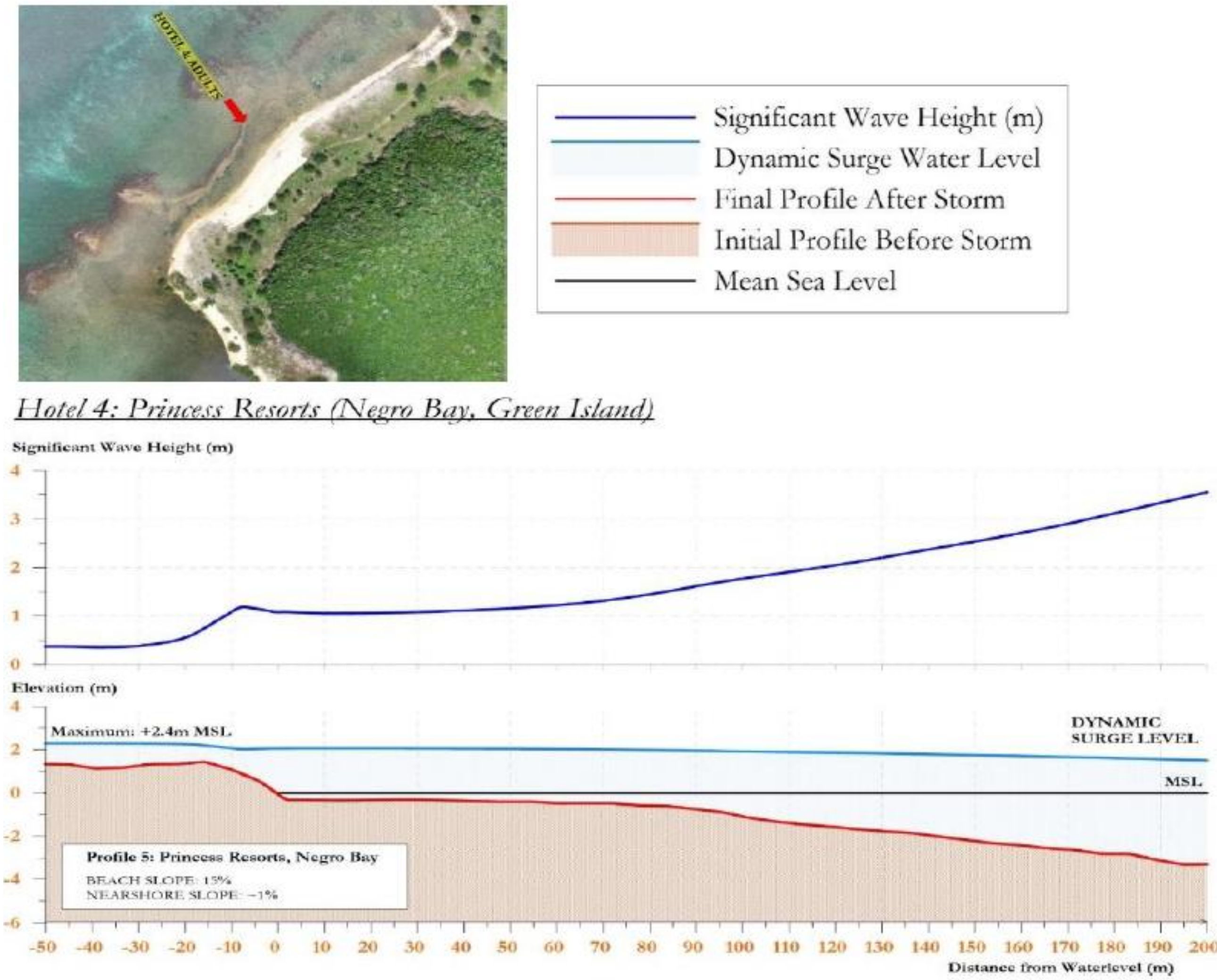


Figure 6-89 Surge levels for Hotel 4

6.4.4 Flooding

Based on the findings of the Community Perception Surveys (Section 7.1.2.1), the minority of interviewed persons indicated that their communities were affected by flooding. Flooding affected these communities during times of heavy rainfall usually once every three months whereby water levels could reach as high as 0.3 – 1.5 metres.

Regarding flooding at or nearby the proposed project site, the minority of interviewed persons stated that it was affected by flooding. Flooding affected these communities during times of heavy rainfall usually once every three months whereby water levels could reach as high as 0.3 – 1.5 metres.

The most flood-affected areas nearby the project site were the Green Island Main Road and Harding Hall.

6.5 CULTURAL AND HERITAGE

The Archaeology Division of Jamaica National Heritage Trust (JNHT) conducted an Archaeological Impact Assessment of the proposed project area and the following sections present the main findings from the associated report.

The detailed **"Archaeological Impact Assessment – Cove, Green Island, Hanover"** is submitted as a standalone report document.

6.5.1 Methodology

A multi-faceted approach was used including oral history and documentary research, the zoning of the project area, archaeological field surveys and data processing.

6.5.1.1 Desk-Based Assessment

This is a thorough review of all the available written and graphic information relating to the area in order to identify the likely character, extent and relative quality of the actual or potential archaeological and architectural resources. It includes relevant historical documents, journals and books, aerial photographs and/or satellite imagery, maps and other contemporary data found in the nation's repositories such as the Island Record Office, National Archives, National Library of Jamaica, University of Technology (UTECH), University of the West Indies (UWI) and private collections. Web sites were also consulted.

Other sources included:

- Historical documentation including, maps, plans, estate accounts, correspondence, titles, deeds, just to list a few.
- Published and unpublished results of any previous archaeological work on the site or in its vicinity.
- Satellite images and aerial photographs.

6.5.1.2 Oral History

Oral history research was conducted in order to bridge the data gap that existed. Persons familiar with the site were interviewed and the information noted to add to the data base on the site.

6.5.1.3 Field Walk Surveys

A Transect Linear Field Walk survey was the archaeological technique employed to identify areas of pre-historic and/or historic activities and features. The site is divided into seven (7) Survey Zones and combed to identify areas of historical/archaeological interest. In areas of disturbed soil, such as uprooted trees and cuttings and crab holes, the soil profile was examined to ascertain the existence or non-existence of cultural stratigraphy below the surface.

6.5.2 Results and Observations

6.5.2.1 Desk-Based Assessment

Historical Background of Cove

TAINO

The Taino are the first known inhabitants of the area. Taino sites have been located at Cousins Cove, Haughton Hall and Rhodes Hall (JNHT SMR). These are in the environs of Cove.

THE SPANISH

The Spanish established settlements at Negrillo (Negril) and made use of Lucea Harbour.

THE BRITISH

The parish of Hanover is at the western end of the north coast. Hanover was founded on 7th January 1724 from the north side of the parish of Westmoreland. At first the parish was to have been named Sophia after the mother of the King George the First, but the Council in Jamaica overruled the Assembly and chose the name Hanover instead. The King was also the ruler of Hannover a German electorate (Espeut, Curtin).

The name Hanover is also found in the parishes of St. Elizabeth and Manchester and a street in Kingston.

The proposed development is to take place at Cove a wetland between Negro Bay and Green Island Harbour. This wetland forms the eastern side of the Green Island Harbour.

A number of sugar estates existed during the 18th century namely Cove, Industry, Harding Hall, Spring Valley, Haugton Hall, Pell River, Caudwell, Saxham and Green Island. Green Island is associated with Captain Bligh of the breadfruit fame.

The Map of Hanover shows the property of Cove having an animal mill (Figure 6-90) (Craskell, 1763).

Figure 6-90 Craskell and Simpson, 1763, map showing an animal mill at Cove

HISTORIC LANDOWNERS

Table 6-47 shows the historic landowners in the environs of the project area. By the end of the 20th century, Cove was in the hands of the Jolly family.

Table 6-47 Historic landowners in the environs

YEAR	PROPERTY	OWNER	No. OF SLAVES	No. OF CATTLE	ACREAGE
1811	Davis Cove	Richard Dickson	46	7	
1816	Davis Cove	Richard Dickson	37	6	
1816	Industry	Clarke, William and Charles James heirs	277	152	
1816	Cousin's Cove	Clarke, William and Charles James heirs	182	145	
1825	Davis Cove	John Dickson	16		
1825	Davis Cove	Mary Dickson	4		
1825	Davis Cove	Mary M. Dickson	4		
1825	Davis Cove	Richard Dickson	10		
1825	Cousin's Cove	William A. Dickson	191	137	
1825	Cousin's Cove	W. F. Dickson	8		
1840	Industry	Rachel Cassely			30
1840		W and J.J Clarke			1276
1840	Davis Cove	William A. Dickson			32
1840	Spring Valley	Robert James			20
1840	Cousin's Cove	George Webster			1642

PAST LAND USE

The surrounding estates produced sugar. Cove produced sugar by an animal mill in 1763. In the early 20th century Coconut, Naseberry and Oranges were planted but most have not survived. Figure 6-91 shows the existence of the morass on a James Robertson map of 1804 (Robertson, 1804).

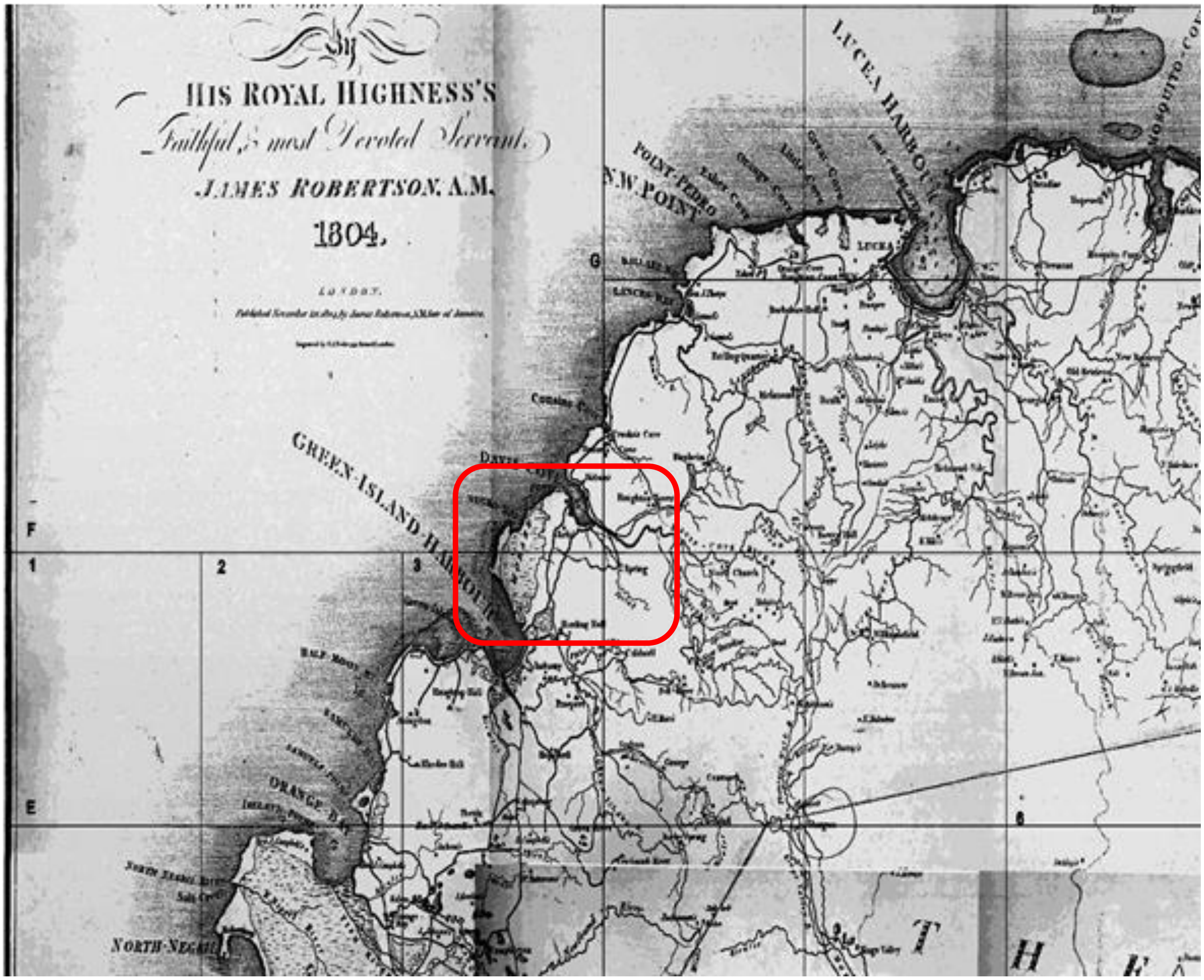


Figure 6-91 James Robertson's map of 1804 showing morass

6.5.2.2 Field Walk Surveys

The area can be classified as a mangrove forest with subtle differences between some of the zones surveyed. Modification is taking place with roads under construction and landscaping giving some areas a park-like appearance. Some sections near the shoreline have been cleared of seaweed revealing white sand and creating a beach.

No historical, archaeological features were uncovered. No artefacts were recovered. Based on the archaeological evidence available at this time, the value of archaeological features and artefact assemblages observed are not significant to the point that they will require a declaration of preservation and there is nothing that will hamper the development of the area. The JNHT has no objection against the proposed development.

6.6 TRAFFIC IMPACT ASSESSMENT

6.6.1 Introduction

Passenger transit, as well as, freight movement are major contributors to Jamaica's economy and thus attributing to high road densities in the country. The proposed Princess Hotel & Resort is to be situated in the parish of Hanover in proximity to the intersection of secondary roads and the primary North Coast Highway (A1) (Figure 6-92). The north coast highway (A1) is the main accessible route to the proposed development of the Princess Hotel & Resort.

The construction and operation of the hotel will generate additional trips that will interact with the existing road network. It is proposed for the hotel property to have two entrance access roads from the A1 Highway (Figure 6-93) (Plate 6-66). It is essential to estimate the existing level of service and the estimate level of service during these phases, in order to identify any potential issues and mitigation measures.

6.6.2 Aims and Objectives

The key objectives of this study are summarized as follows:

- **Road Condition Assessment** - to determine the existing conditions between the selected intersections. Road conditions were assessed by identifying various pavement distresses, their locations, frequencies and measurements, as well as the overall rideability of the road surface.

- **Traffic Impact Statement** - required by the National Works Agency. This is to be submitted as a part of the development application. It involved conducting the necessary fieldwork and analysis to prepare and submit a report with recommendations to minimize any impact the hotel will have on traffic in the area.

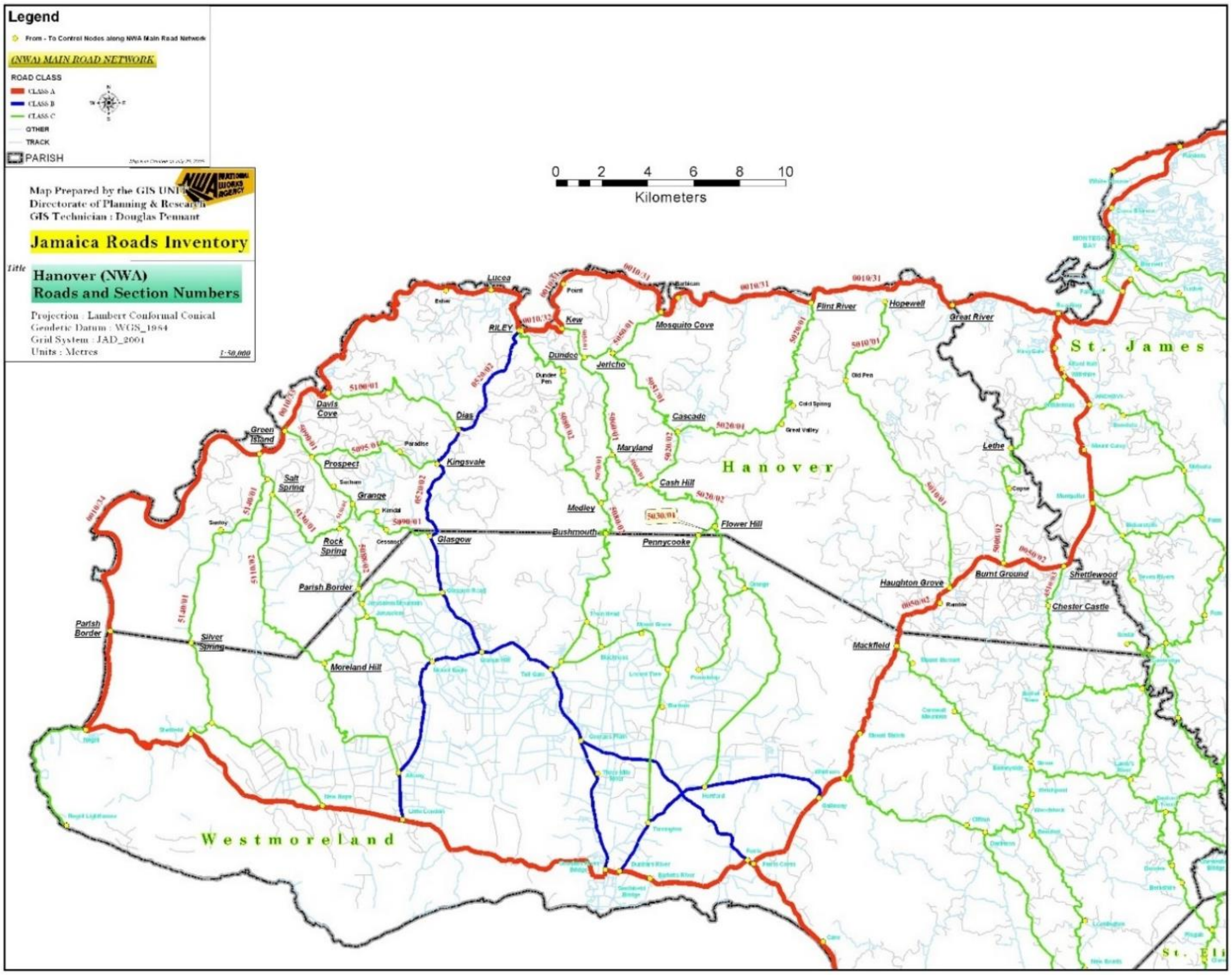


Figure 6-92 NWA Road Inventory Map – Hanover and Westmoreland

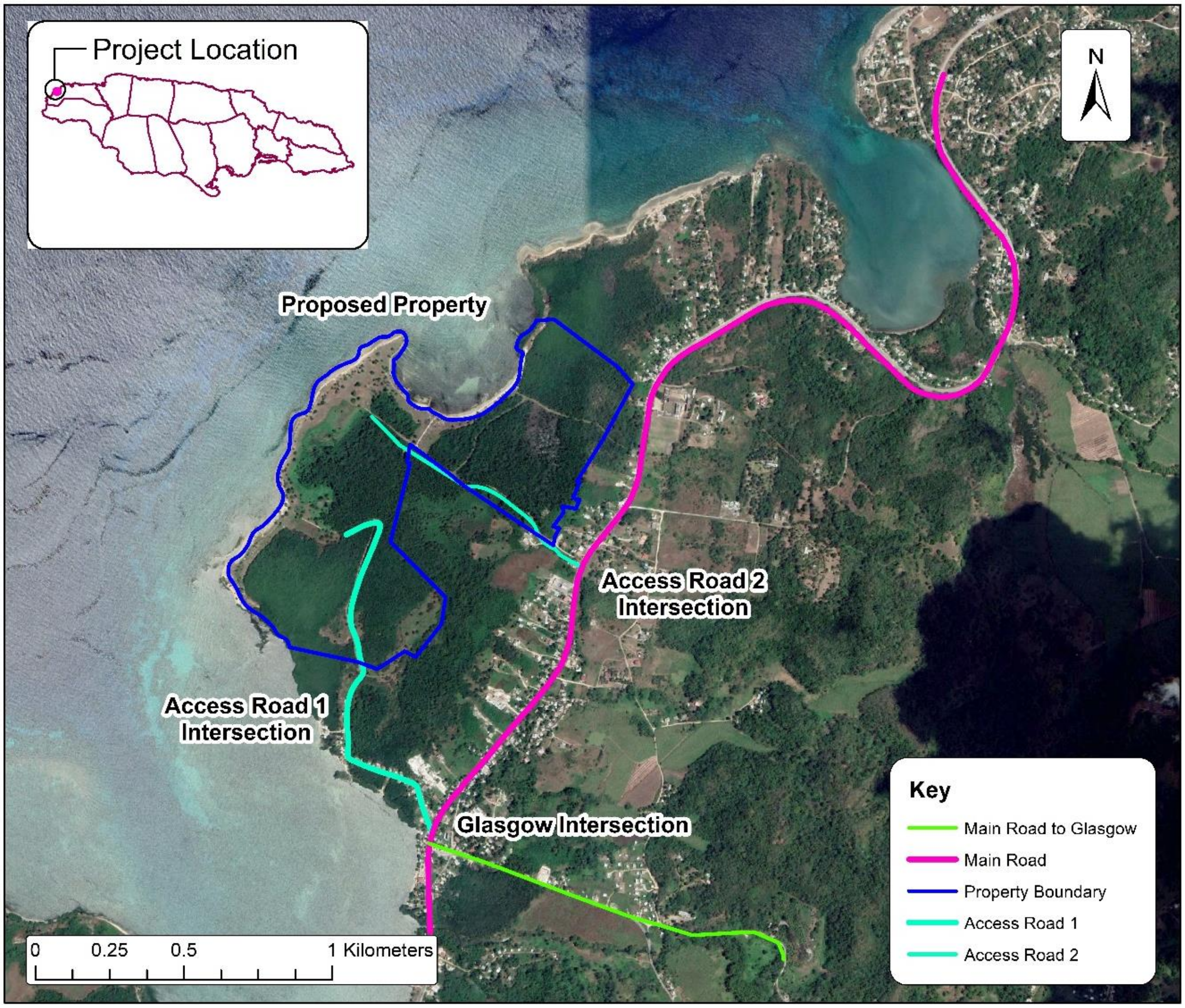


Figure 6-93 Hotel location in relation to main road and access roads

Plate 6-66 Access Road 1 intersection (left); Access Road 2 intersection (right)

6.6.3 Road Condition Assessment

6.6.3.1 Scope

The International Roughness Index (IRI) and the Pavement Conditional Index (PCI) were the two evaluations that comprised the road condition survey. Data for the various parameters were collected and stored using the TotalPave software. This was done for approximately 7 km of paved roads within the study area encompassing the two intersections to be assessed, and a 500 m buffer north and south of the intersections. The IRI exercise required the travelling along 7 km of sections of the A1 road within the project area, three times (once per lane-direction) and at a uniform speed.

6.6.3.2 Methodology

Pavement Condition Surveys are performed to give an indication of the physical conditions and serviceability of pavements in order to monitor and implement mitigative actions for deteriorated or failed pavement sections. These surveys are important to facilitate easily accessible and functioning road transportation networks. PCI and IRI are two non-destructive methods of evaluating pavement performance. The PCI involves a visual condition assessment to characterize distresses and the respective dimensions along the pavement surface. The TotalPave PCI Calculator application that was used allowed for information regarding types of distresses and their measurements to be inputted and logged to a cloud-based server in real-time. The logged distresses were then scored according to a standard procedure developed by the American Society of Testing Materials (ASTM). The IRI, initially developed in 1986, has been adapted to many different methods, all varying in advantages, however, one of the most accessible method is the use of an inertial profiler. This type of device uses accelerometers and sensors to detect changes in axes and correlate this to the road roughness condition. The TotalPave IRI collector used required a smartphone device and the TotalPave application designed to collect and process data. Raw acceleration, GPS and magnetometer information was then collected and logged from the smartphone while driving at a uniform speed. Once results were obtained for each respective survey, the data was compared to standard ratings to determine the extent of deterioration or the roughness thus ride quality of the pavement.

Pavement Condition Index (PCI)

Pavement Condition Index (PCI) is a convenient and non-destructive way to monitor the condition of pavement surfaces and to identify maintenance and rehabilitation needs. The PCI is a subjective method of evaluation based on observation and inspection of the distresses present on a pavement surface at specified intervals. It provides a numerical rating system (from 0-100) for the condition of road surfaces, with 0 being the worst possible condition and 100 the best. Pavement distresses are logged based on type, extent and severity. The collected data is then used to calculate a score for the PCI according to their standard PCI Rating Scale as shown (Figure 6-94). The survey is standardized by the American Society of Testing Materials and given the designation D6433[3].

Though the PCI does not measure structural capacity, roughness or skid resistance it does provide an objective, rational way to determine the maintenance and repair needs of roads. Continuous monitoring of PCI values allows for the establishment of a database that can be used to predict rate of deterioration and schedule maintenance accordingly. It can also be used to check the effectiveness of several road rehabilitation measures. The PCI Survey Application provided by TotalPave conforms to the American Society of Testing Materials Standard D6433 or the “Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys. The model requires the following inputs:

- Pavement Width
- Pavement Section Length
- Pavement Distress Type and Severity

The road survey of the sections of A1 within study area were logged in 17 m increments. Distresses were not recorded for the skipped intervals of 65 m. The PCI survey was done for 2 km of roadway including the intersections to be assessed and 500 m buffers north and south of the intersections.

[3] ASTM International; “Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys”; December 2007

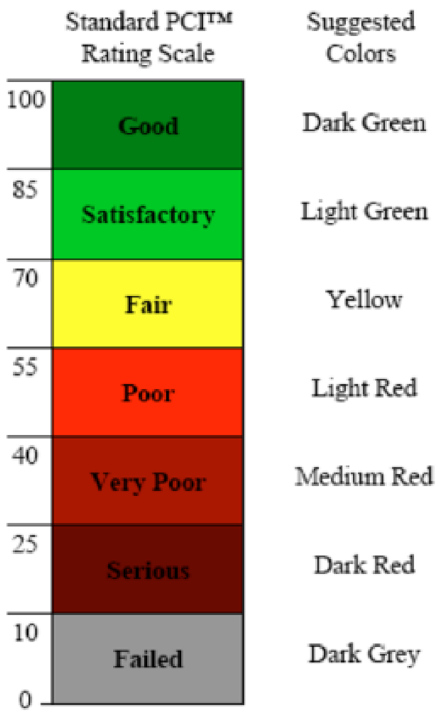


Figure 6-94 Pavement Condition Index (PCI) Rating Scale and Suggested Colours, ASTM D 6433

International Roughness Index (IRI)

Pavement roughness is an expression of irregularities in the longitudinal profile of pavement surfaces that adversely affect the pavement ride quality for users. The rougher a pavement, the lesser the quality of the ride but conversely the smoother the pavement the better the ride quality. Roughness is typically monitored for all pavement management systems as it is a not only an indicator of the comfort of motor vehicle trips but is proportional to vehicle delay, fuel consumption and vehicle maintenance costs. Developed by the World Bank in the 1980's, the International Roughness Index (IRI) is based on a ratio of a vehicle's accumulated suspension motion (vertical travel) in mm divided by the longitudinal distance travelled in km. This ratio called the Average Rectified Slope (ARS) is then multiplied by 1000 to give the IRI. (Figure 6-95).

ARS = Accumulated Suspension Motion (mm)/Distance Travelled

*IRI = ARS * 1000*

Similar to the PCI, IRI readings were logged in 1km increments. In each increment two readings were taken for the IRI, one for each lane along the single carriageway. The two values were then averaged to give a roughness reading for that block in each increment. The IRI survey was done for 7 km of roadway in the study area.

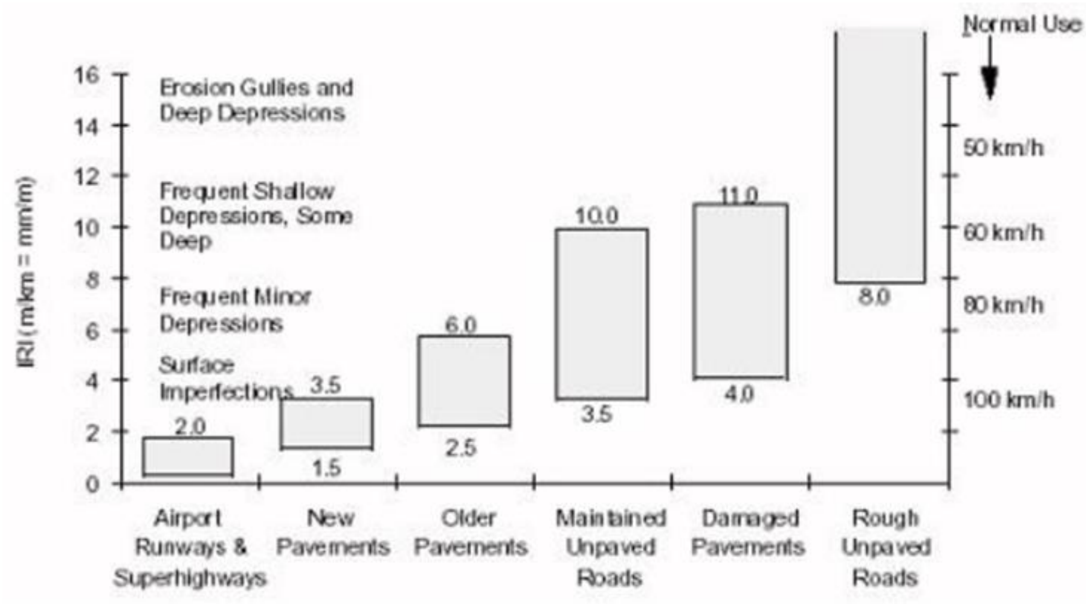


Figure 6-95 IRI roughness scale (replotted from Sayers et al., 1986).

Verification: Comparison to Standard Inertial Profiler Results

Prior to official fieldwork in Hanover, the TotalPave mobile application software was tested in Jamaica on the Marcus Garvey Highway and Portmore Causeway Roads. These roadways were previously evaluated with a vehicle-mounted standard inertial profiler. The results of the Total Pave software were consistent with that of the Inertial Profiler and were summarized in Table 6-48.

Table 6-48 Summary of verification exercises for IRI using Total Pave system compared to standers profilers

Roads/Locations	National Works Agency (Jamaica)	CEAC Co. Ltd. (Engineer) Verification
Marcus Garvey Drive (rum store road to 4th Avenue)	1.5 to 2.5 (done 2016)	1.5 (2018) for section of road where rehabilitation works were not done in 2017. Rehabilitated sections have values in the order of 0.99
Portmore Causeway 3+000 to 4+000	1.9-2.3 both directions	2.1 both directions (2018)

6.6.3.3 Results

Road Condition

Results from the PCI indicate that 8% of the 2km of road surveyed was in fair to good condition and the remaining 92% ranged from failed to poor condition. Some of the distresses identified included alligator, block, edge, longitudinal and transverse cracking, lane shoulder drop-off, potholes, patch deterioration, ravelling and weathering (Plate 6-67). It was observed that the road itself in different sections were of low to medium severity, however, much of the sections of the road that were classified as failed using the PCI scale calculator, may have been as a result of the road shoulders being in very poor to failed conditions. From observation, most of the road shoulders along the 2km surveyed, were heavily weathered and in some sections were non- existent. In summary, overall PCI values indicate that the 2 km of road surveyed were of poor to very poor condition, with the road shoulders being the major contributors attributing to such low PCI values (Figure 6-96 and Figure 6-97). Given that majority of the road surveyed was classified as poor to failed condition, it may be necessary to resurface the existing pavement to correct the aforementioned surfaces distresses.

a) Alligator Cracking and Weathered Shoulders

b) Block Cracking

c) Longitudinal and Block Cracking

d) High eroded shoulders

Plate 6-67 Distresses identified along the road surface

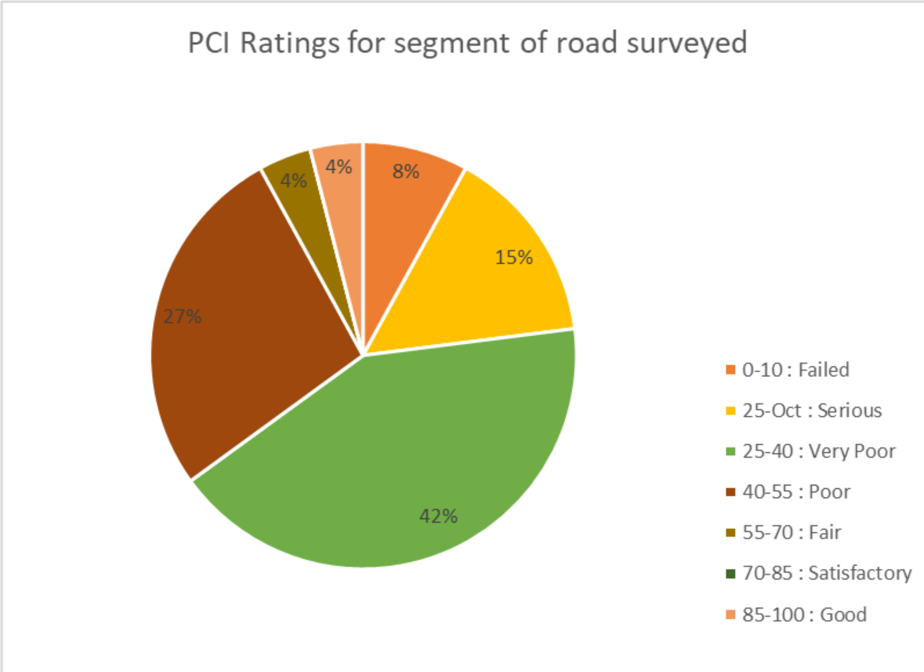


Figure 6-96 Portions of PCI Ratings for Assessed Road Segment

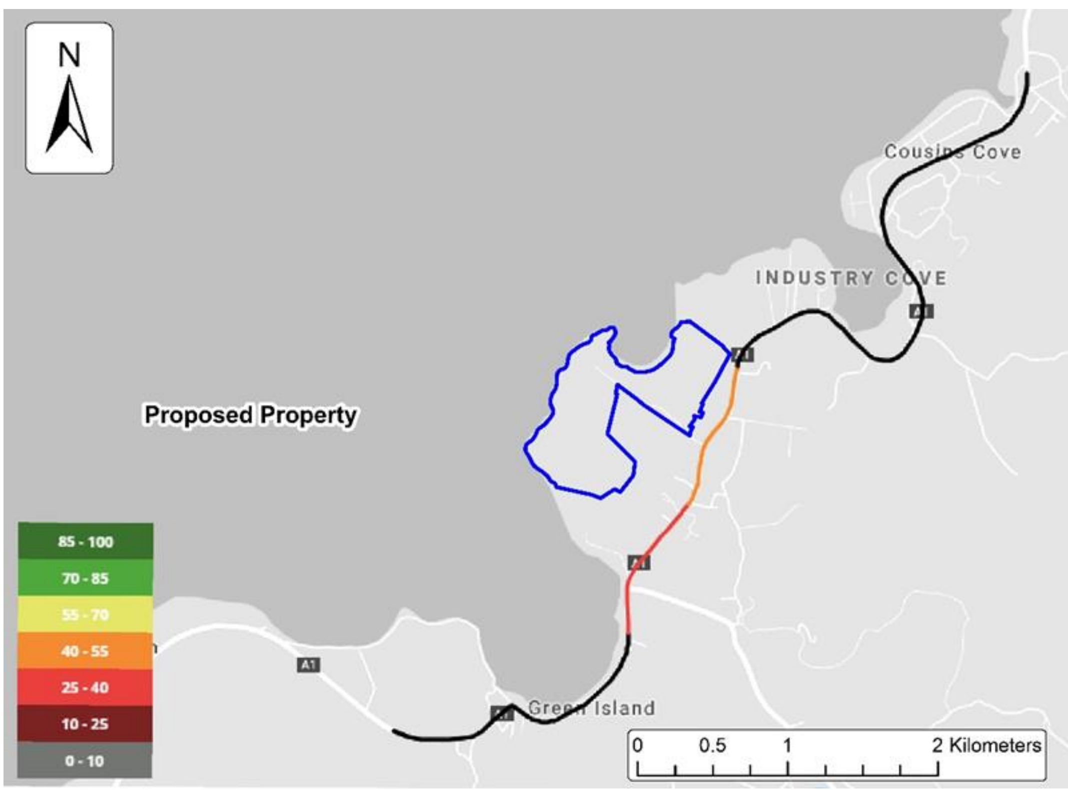


Figure 6-97 PCI Ratings for each segment of Roadway

Ride Quality

An IRI score between 0 and 2 is representative of an airport runway or superhighways with no imperfections. An IRI score of 4.0 corresponds to older pavement conditions with few surface imperfections. Results for the IRI indicated that the eastbound lane, towards the direction of Lucea, was of a slightly better ride quality than that of the westbound lane. Less than 50% of the lanes both in the direction to Lucea and Negril recorded values within the 2-3 and 3-4 IRI band. These bands can be classified as pavements being of *fair* to *satisfactory*.

For the lane in the direction to Negril, 41% of values recorded were within the 4-5 IRI band while for the lane in the direction to Lucea, 18% of values recorded were within the 4-5 IRI band (Figure 6-98). For IRI scores between 4 and 5, a pavement may be classified as one that is in poor condition. Both lanes to Negril and to Lucea recorded 27% and 36% of values, for Negril and Lucea respectively, within the 5-7 IRI bands (Table 6-49 and Figure 6-99). Sections of the pavement that recorded these values can be classified as being of very poor condition, thus in need for major rehabilitation. Overall the IRI values revealed that majority of the road segment surveyed was of poor to very poor condition and thus in need of rehabilitation actions.

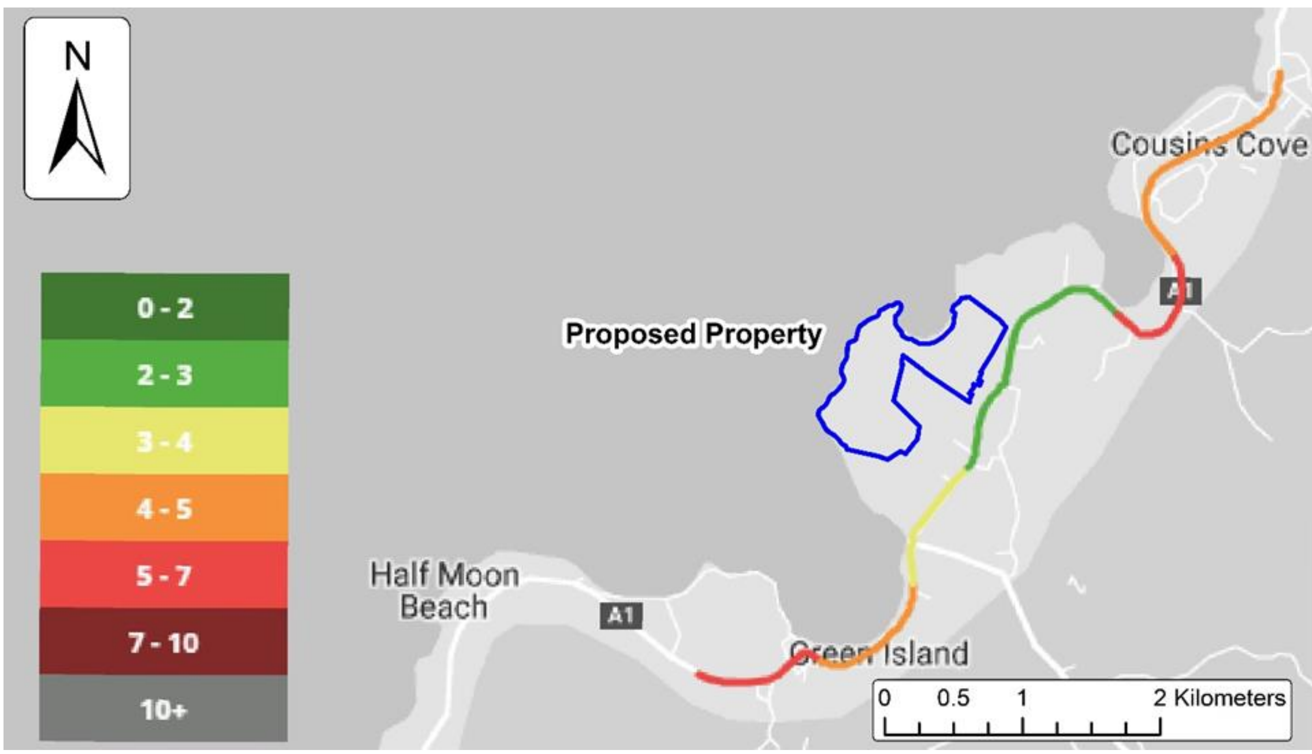
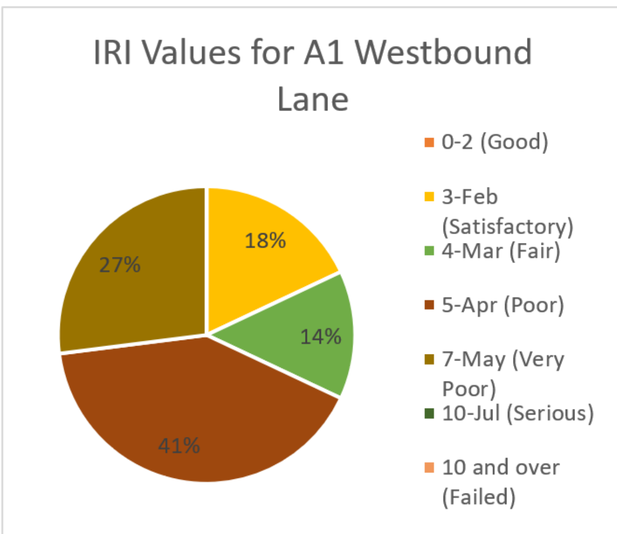


Figure 6-98 Map showing IRI values for each segment of Roadway

Table 6-49 IRI Rating for Road Sector Assessed

Lane to Negril			Lane to Lucea			Recommended Action
IRI Scale	***Length (km)***	***%***	***IRI Scale***	***Length (km)***	***%***	
0-2	0	0	0-2	0	0	Preventative Maintenance
2-3	4	18	2-3	4	18	Preventative Maintenance
3-4	3	14	3-4	6	27	Minor Rehabilitation
4-5	9	41	4-5	4	18	Minor Rehabilitation
5-7	6	27	5-7	8	36	Major Rehabilitation
7-10	0	0	7-10	0	0	Major Rehabilitation
10 +	0	0	10 +	0	0	Reconstruction
TOTAL	22	100	TOTAL	22	100	



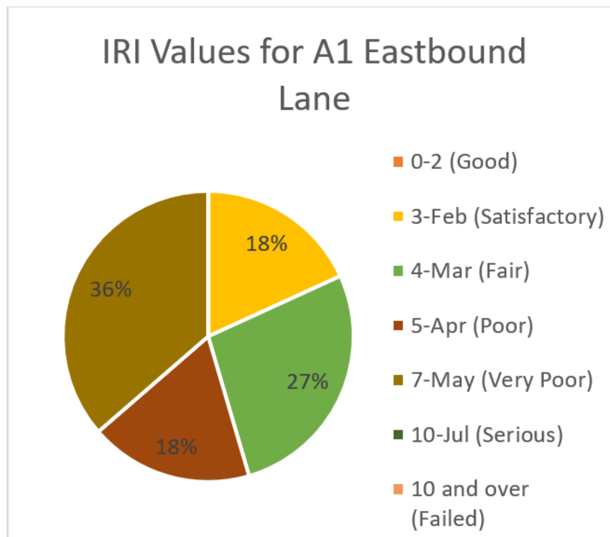


Figure 6-99 Pie Charts showing portions of IRI Ratings for Assessed Road Segment

6.6.3.4 Conclusion

The road condition assessment was done to determine the existing road conditions between the selected intersections that will affect the proposed Princess Hotel in Hanover, Jamaica. Overall, averaged IRI values portrayed an existing old pavement with majority of the pavement sections classified as *poor* to *very poor*. A plethora of road distresses were observed within the 2 km of road surveyed. Overall, PCI values also revealed that the total road segment surveyed was of poor to very poor condition, with the road shoulders being the major contributors to such low PCI values. In summary, the road condition assessment revealed that the existing conditions between the selected intersections were poor, thus repair work would be necessary to correct the surface distresses and to improve ride quality.

6.6.3.5 Recommendation

Road rehabilitation should be considered after hotel construction. Given the IRI and PCI values collected from the road survey, it is recommended that for sections of the road with minor distresses or small localized cracking, the causes of the distresses should first be identified followed by the appropriate repair work, for example, patching over the repaired subgrade. For large distressed sections of the road indicative of structural failure, likewise, the causes of the distresses should firstly be identified. Consequently, an entire hot mix asphalt (HMA) overlay may be necessary to not only structurally carry the anticipated loading, but also to improve ride quality.

6.6.4 Traffic Impact Assessment/Statement

6.6.4.1 Objectives

Key objectives of this exercise are summarized as follows:

1. Define the general environment in which the development will be constructed by conducting traffic counts in the vicinity of the A1 Highway and the Glasgow Intersection.
2. Determine the Average Daily Traffic (ADT) and Peak Hourly Traffic (PHT) along the road and major intersections adjacent to the project site.
3. Determine the expected ADT and PHT at the proposed entrances during construction and Post Construction (with unsignalized and signalized scenarios).
4. Determine the level of impact the development will have while recommending mitigative actions.

6.6.4.2 Methodology

The approach involved meeting with the National Works Agency (NWA) and other relevant stakeholders to guide the assessment scope and methods. The methodology included the following:

5. Project inception meetings
    a. Meet with client to collect project information and details required.
    b. Meet with the NWA to discuss project parameters and assumptions that will be made to refine the scope of works required for approvals.
6. Desktop Data Collections
    a. NWA Road Network
7. Field Data Collection
    a. Conducting traffic counts between the hours of 6:00 AM and 6:00 PM over three days as per NWA specification at the agreed location.
    b. Field parameters to include:

i. Signage and road markings
ii. Lane and shoulder widths
iii. Sight distance
iv. Grade (slope of road)

8. Impact Analysis by using:
   a. The capacity analysis methodology published in the Highway Capacity Manual (HCM) 2000 edition. Sidra Intersection 8.0 traffic analysis software to analyse the intersections performance pre-development, during construction and post construction.

6.6.4.3 Existing Conditions

Roads and Intersections to be Impacted

It is expected that the overseas guests of the resort will primarily travel by shuttle bus to and from the resort and around the island. This will significantly decrease the need for individual trips being generated per room/guest. This in turn will also limit the impact on hotel entrance intersections with the highway. Discussions with the NWA indicated the key area of focus should be the entrances to the development, and the associated impacts on the highway's (A1) level of service.

Road Classification and Capacity

The National Works Agency has developed a table of criteria for the roads in Jamaica. This is the standard to which the existing roads are compared for level of service and capacity requirements. This table is found in the NWA Development Manual[4]. In addition, the Green Island Main Road is a Class A (Major Arterial Highway) which connects the western section of the island, Kingston and other major areas in the central and eastern section of the country. It forms a part of the national road network that is maintained by the National work Agency (NWA). Average daily traffic on these roads are generally in excess of 1,000 vehicles both ways.

Speed Limits and Sight Distance

The existing sight distances exceed the required for both controlled intersections and highway conditions. The posted speed limit in the vicinity of the development is 50 km/hr which is typical for developed areas. Sight distance is the length of roadway ahead that is visible to the driver. The available sight distance on a roadway should be sufficiently long to enable a vehicle travelling at or a near the design speed to stop before reaching a stationary object in its path. Although greater lengths of visible roadway are desirable, the sight distance at every point along a roadway should be at least that needed for a below-average driver or vehicle to stop. The sight distances at the entrances of the proposed development is approximately 200m in the northern direction and 175m in the southern direction along the A1 for the Access Road 1 Intersection, and 300m in both the northern and southern directions along the A1 for the Access Road 2 Intersection. Sight-distances are not expected to be an issue for the intersections.

[4] [4] Development and investment Manual, Vol 3, Section 1 Roads, Infrastructure, Drainage and Traffic Management, p.4

6.6.4.4 Traffic Volumes

It was necessary to determine the volume of traffic along the main road in order to assess the impacts the construction/operation of the hotels may have on the overall level of traffic on the road as well as the impact at the entrances of the two hotels.

CEAC Solutions undertook manual traffic counts for three consecutive weekdays in the vicinity of the proposed development; between the hours of 6:00 AM to 6:00 PM, from October 22 to 24, 2019. Additionally, counts were also undertaken at the Glasgow Intersection (below Access Road 1 and along highway) to assess its impact on the volumes and level of service for the proposed property.

The traffic counts were collected at 15 minutes intervals for different categories of vehicles – motor buses/trucks, motor cars and other. The data was used to determine the peak hours of traffic. Hourly totals were determined by multiplying the peak (15 minutes) by 4 as recommended by the National Works Agency.

As neither of the proposed access roads are developed, there was no significant traffic entering or exiting these entrances. Though the area has a high volume of moving traffic, the stream primarily moves towards Negril and Lucea, with a fraction going to and from Glasgow. The traffic counts revealed that there are generally two peaks during the day; with the most significant being the evening peak occurring between 5:00PM and 6:00 PM. This typically corresponds to the regular after work or school day, with commuters on their way home (Table 6-50 and Figure 6-100).

Table 6-50 The 3-day average of the hourly flow volumes near to the proposed development, October 2019

Time	From Negril (to Lucea)	From Lucea (To Negril)	Left to Glasgow (From Lucea)	Right to Glasgow (From Negril)	Glasgow to Lucea	Glasgow to Negril	Total
6:00 AM - 7:00 AM	99	147	51	43	69	97	505
7:00 AM - 8:00 AM	172	175	53	44	71	61	576
8:00 AM - 9:00 AM	201	226	58	87	67	92	731
9:00 AM - 10:00 AM	232	189	36	62	59	59	637
10:00 AM - 11:00 AM	186	161	54	40	42	55	537
11:00 AM - 12:00 PM	205	165	44	37	42	49	542
12:00 PM - 1:00 PM	186	186	40	47	42	31	532
1:00 PM - 2:00 PM	156	168	51	35	29	49	487
2:00 PM - 3:00 PM	177	157	66	50	36	17	503
3:00 PM - 4:00 PM	202	183	51	68	49	53	606
4:00 PM - 5:00 PM	212	149	51	78	49	28	567
5:00 PM - 6:00 PM	268	224	50	77	35	40	694
Total	**2295**	**2130**	**605**	**667**	**589**	**630**	

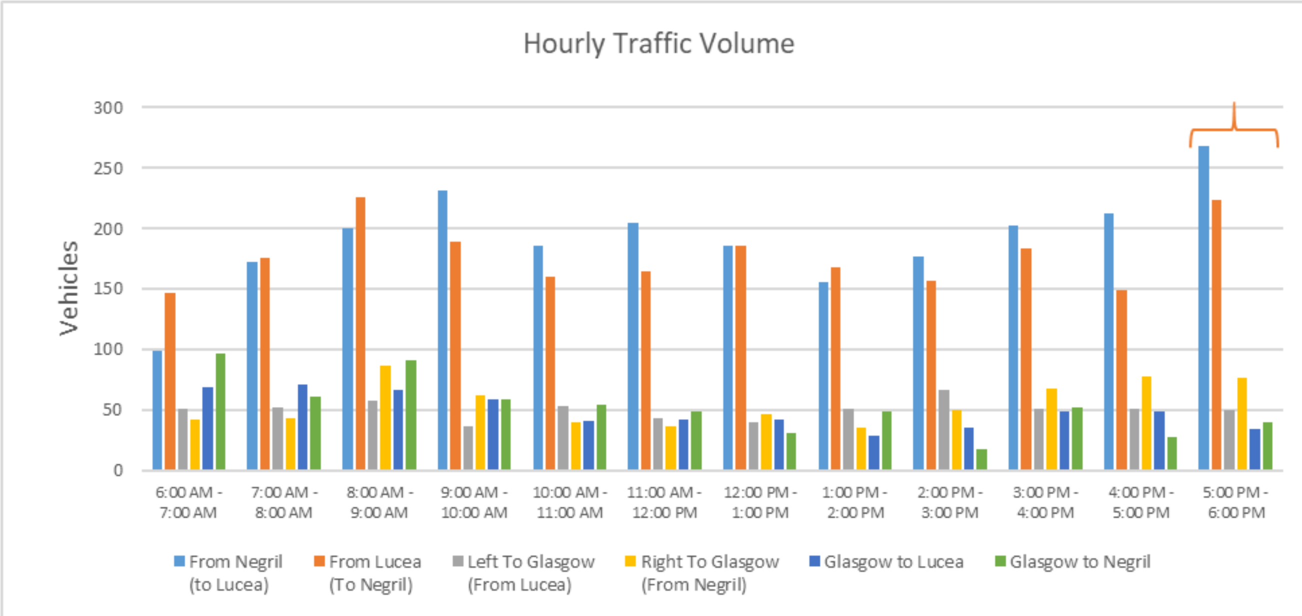


Figure 6-100 Hourly traffic volume at the intersections

6.6.4.5 The Development

Entrance Requirements

The proposed development plan indicates that there will be two (2) entrances to the proposed site; one (1) to the south in the vicinity of the Glasgow Intersection, and the other 1km further north. At present, the design layout of the roadway has no accommodation for these entrances as they are rarely traversed. Acceleration and Deceleration Lanes may be not be required but are recommended when hotel operations commence.

Trip Generation

It was necessary to estimate the number of trips that will be generated both during construction and during the operation period of both access road intersections.

Construction trip generation was estimated from both observations and reference to previous studies. Civil works such as filling, and excavation are expected to generate the most significant heavy vehicle traffic. Likewise, workers coming to and going from the site in the morning and evening sessions are also expected to generate significant traffic. A review of trip generations of previous studies is summarized in Table 6-51. Based on experience with construction of similarly sized resorts, it was assumed that the number of deliveries that will be made during the peak hour is six (6), three (3) entering and three (3) leaving. This will be controlled by the construction team who will coordinate the deliveries mostly to off peak hours to minimize the impact on traffic and safety.

During the operation period, the trips will mostly be generated by staff buses, guest buses and deliveries. The Trip Generation Manual[5] indicates the peak hour trips for a resort hotel is 0.49 trip per room or 453 trips for Hotel 1 and 441 trips for Hotel 2 during the peak hour. However, these values are not representative of the local proposed conditions. The development information indicates the Princess Resort will be catering mostly to foreign guests and that the guests will be transported by bus to and from the airport; secondly there will be offsite parking and shuttle services for employees and limited onsite parking for guests. Counts were conducted at the entrance of a similar hotel with similar arrangements along the Lilliput main Road in St. James, having a room count of 350. The total peak hour trips were in the order of 28 which yielded a trip generation rate of 0.08 per room. Therefore, a Trip Generation Rate of 0.14 was used to represent a worst-case scenario for proposed development, which yielded a peak hour trip generation value of 139 for Hotel 1, and 135 for Hotel 2. The rate is expected to remain as long as the hotel's operating programme remains unchanged.

Table 6-51 Summary of previous trip generation rates used for hotel projects

Previous study	Construction trip generation rate	Operation trip generation rate
Grand Lido Resort and Spa Negril, Westmoreland	For worst case scenario ten heavy duty vehicles is expected during the peak hours	
Hard Rock Hotel, Rose Hall, St. James	During the construction period, the anticipated number of deliveries that will be made during the peak hour is six (6), three entering and three leaving	
RIU Hotels & Resorts Mahoe Bay Montego Bay, St. James		Trip Generation rate (trip per occupied room) =65/762 = 0.08 =92/762 = 0.12

Traffic-related impacts and Level of Service for both construction and operational phases are discussed in Section 8.2.3.5 and 8.3.4.6 respectively.

[5] Institution of Transportation Engineers; "ITE Trip Generation Manual: 7th Edition";2003.

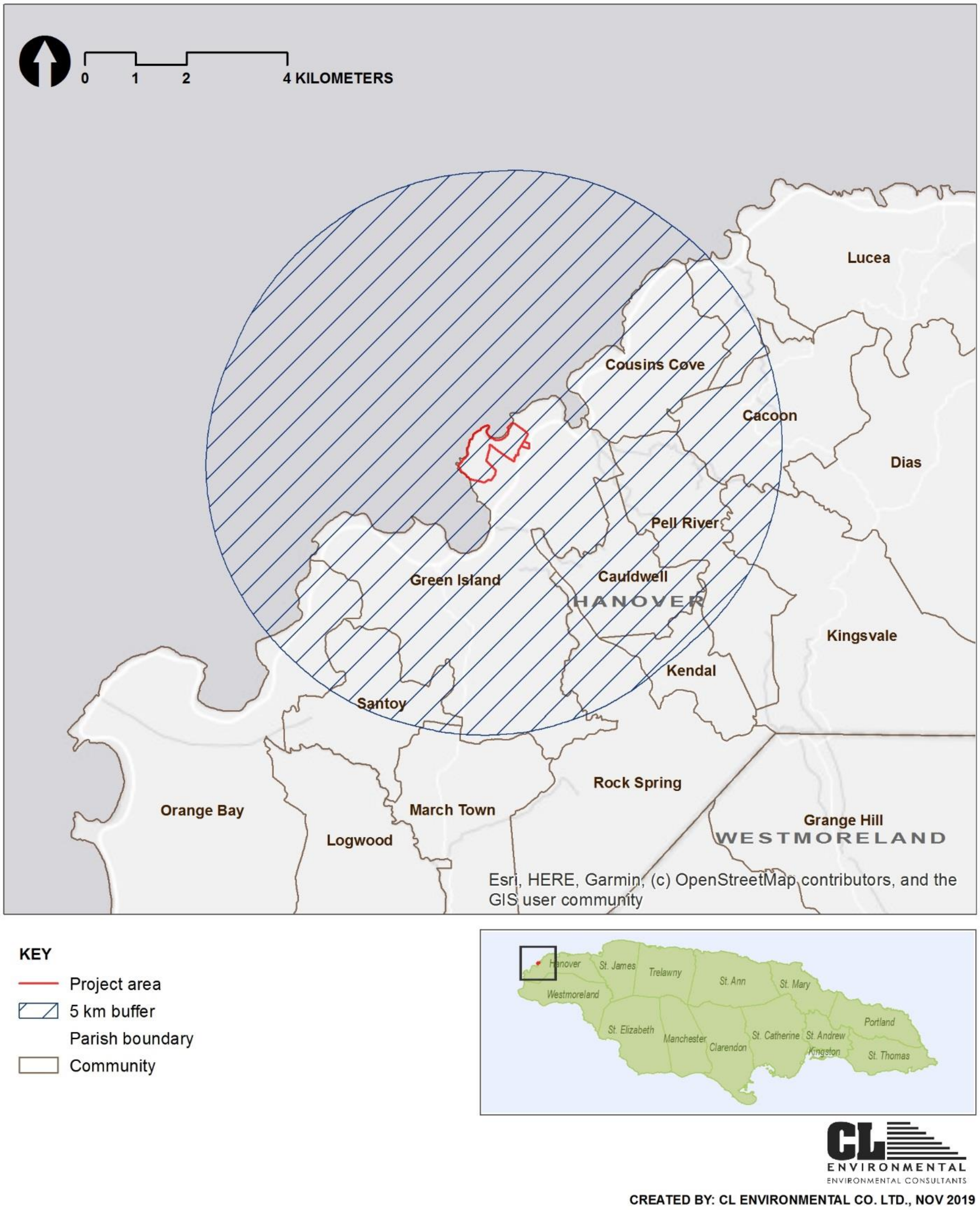
6.7 SOCIO-ECONOMIC ENVIRONMENT

6.7.1 Approach

6.7.1.1 Social Impact Area

In order to assess the various social elements of the proposed project, a Social Impact Area (SIA) is established. An SIA may be described as the estimated spatial extent of the proposed project's effect on the surrounding communities. Demographic analyses are carried out utilising this SIA demarcation, and social services, infrastructure and industrial facilities are described in relation to this area as well. For the purposes of this project, the SIA encompasses a five (5) kilometre buffer around the proposed project area (Figure 6-101). The total land portion of the SIA is 51.9 sq. km in area, with the remaining north-western section of the SIA extending over the Caribbean Sea. The project is located in the community of Green Island; however, the SIA extends fully or partially over 12 communities in the parish of Hanover:

1. Cacoon
2. Cauldwell
3. Cousins Cove
4. Green Island
5. Kendal
6. Kingsvale
7. Lances Bay
8. March Town
9. Orange Bay
10. Pell River
11. Rock Spring
12. Santoy



Source: Communities (Social Development Commission, SDC)

Figure 6-101 Social Impact Area (SIA) for the proposed project

6.7.1.2 Demographic Analyses and Census Database

Population data from the Statistical Institute of Jamaica (STATIN) 2011 Population Census database by enumeration district (ED) was the main input to the demographic analyses. It should be noted that all Census data relates to the resident population and does not take into consideration persons working in or visiting the ED.

The Census spatial datasets (for population, housing, dwellings and education) were clipped to the SIA using Geographic Information Systems (GIS) tools. For those EDs that were only partially within the SIA, the percentage of the clipped area was calculated based on area and applied to the data to provide proportionate estimates of population and housing statistics. For example, if 25% of the ED's area was included in the SIA, the total population or number of households within that ED would be multiplied by 0.25 in order to estimate the population/ households found within that portion of the ED enclosed by the SIA. Indeed, this assumes an even distribution of persons/households within the ED, which may not be the case; however, it was deemed necessary to approximate the proportional numbers for these partially included EDs, rather than removing or including the entire ED population.

The following computations were made in order to derive various demographic indicators:

- ***Population growth*** - was calculated using the formula [$P_n = P_o (1 + r)^t$]; where P_o is the population at the beginning of a period, t is the period of time in years, r is the annual rate of increase, and P_n is the population at the end of the period (United Nations, 1952).
- ***Population density*** – was derived by dividing the population by the land area. This is useful for determining the locations of greater concentrations of population.
- ***Dependency ratio*** – was calculated using the formula [child population + aged population /working population X 100], where the child population is between ages 0-14, the aged population is 65 & over and the working population is between ages 15-64 years. This ratio is useful for understanding the economic burden being borne by the working population.
- ***Male sex ratio*** – was calculated by using the formula [male population / female population X 100]. This in effect denotes the number of males there are to every 100 females and is useful for determining the predominant gender in a particular area.
- ***Domestic water consumption*** - was calculated based on the assumption that water usage is 227.12 litres/capita/day and sewage generation at 80% of water consumption. Water consumption for workers in Jamaica is calculated at 19 litres/capita/day and sewage generation at 100% water consumption.
- ***Domestic garbage generation*** - was calculated at 4.11 kg/household/day (National Solid Waste Management Authority).

6.7.1.3 Other GIS Data and Information Sources

Geospatial data for various services and infrastructure, including schools, health centres, hospitals, police stations, fire stations and post offices were obtained from the Mona GeoInformatics Institute (MGI). Information gleaned from community profiles created by the Social Development Commission (SDC) are included throughout this section; those available for communities traversed by the proposed alignment are as follows:

- Anchovy
- Bogue
- Catherine Hall
- Green Pond
- Montego Bay Business District
- Montpelier
- Mount Carey
- Orange Irwin
- Pitfour
- Porto Bello
- Salt Spring
- Seven Rivers
- Tucker
- West Green

Other data sources are stated throughout and include organizations such as the Forestry Department, Planning Institute of Jamaica (PIOJ), Water Resources Authority (WRA) and the National Environmental Planning Agency (NEPA). Additional data were also gleaned from the 1984 national topographic maps (metric series) and satellite imagery available for the project.

6.7.2 Demography

6.7.2.1 Population Growth and Density

The total population within the SIA in 2011 was approximately 10,380 persons (STATIN 2011 Population Census). With the land area within the SIA being approximately 51.9 km^2, the overall population density was calculated to be 200 persons/km^2. This population density is lower than the national level (245 persons/km^2), but higher than the Hanover regional density of 154 persons/km^2 (Table 6-52).

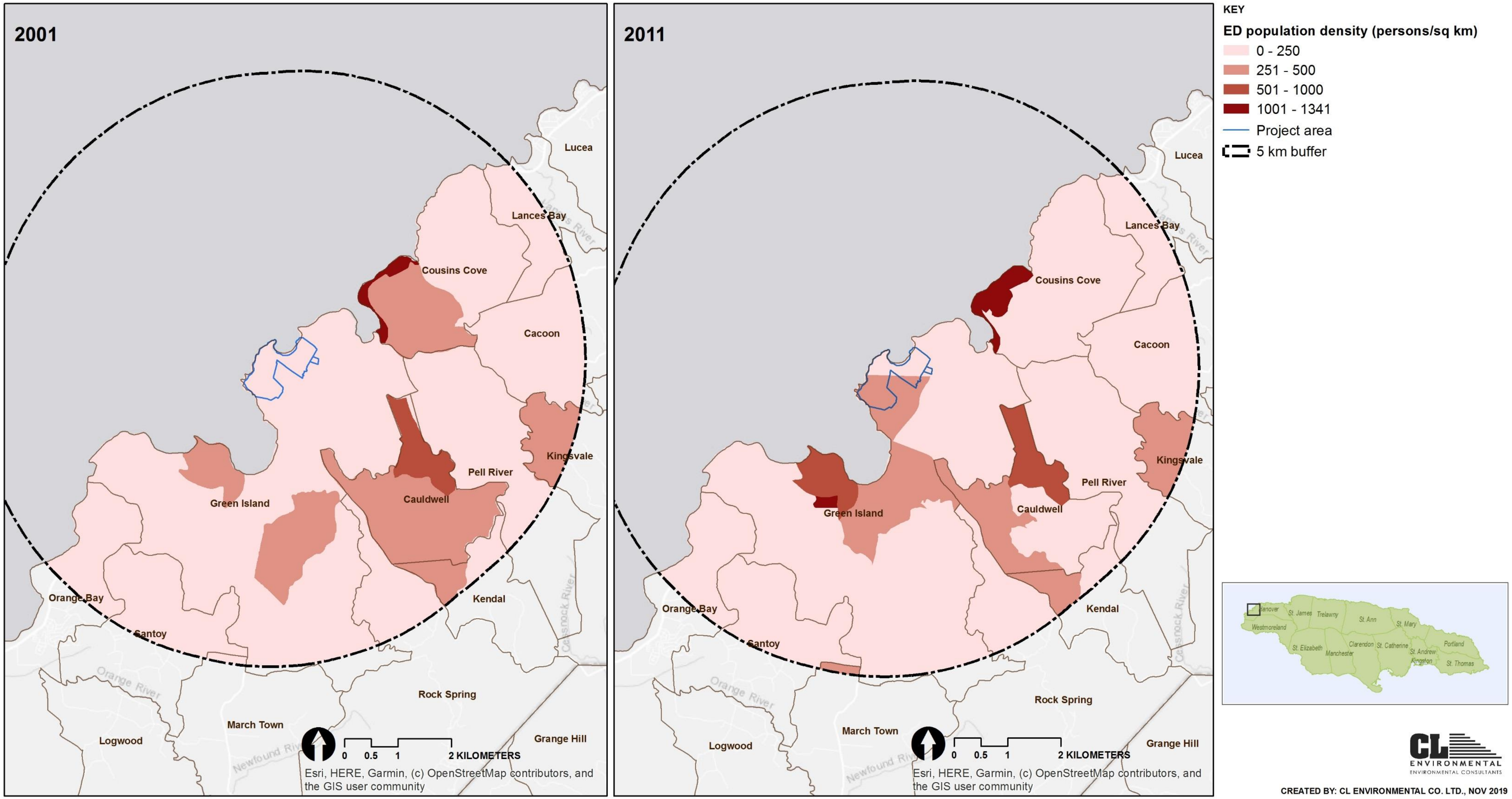
Table 6-52 Comparison of population densities for the year 2011

Source: STATIN Population Census 2011

Category	Jamaica	Hanover	SIA
Land Area (km^2)	10,991.0	450.8	51.9
Population	2,697,983	69,533	10,380
Population Density	245	154	200

Examination of the 2001 population data showed that there were approximately 9,127 persons within the SIA in 2001; therefore, the growth rate within the SIA between 2001 and 2011 was approximately 1.29% per annum. Based on this growth rate, at the time of this study (2019), the population was approximately 11,504 persons and is expected to reach 15,867 persons over the next twenty-five years if the current population growth rate remains the same. The growth rate per annum for the SIA (1.29%) differs from than that for the parish of Hanover (0.38%) and the island (0.36%) between 2001 and 2011 (STATIN, 2011). Using the regional rate for Hanover, the population in 2019 is estimated to be 10,699 persons, and in 2044, between 11,764 persons.

Figure 6-102 depicts the population density within each enumeration district (ED) for the years 2001 and 2011. Although the enumeration district boundaries changed between these years, obvious increases in population density are evident in Green Island, within the immediate project area and south of the project land.



Data source: STATIN Population Census 2011 and 2001

Figure 6-102 SIA 2001 (left) and 2011 (right) population density by enumeration districts

6.7.2.2 Age & Sex Ratio

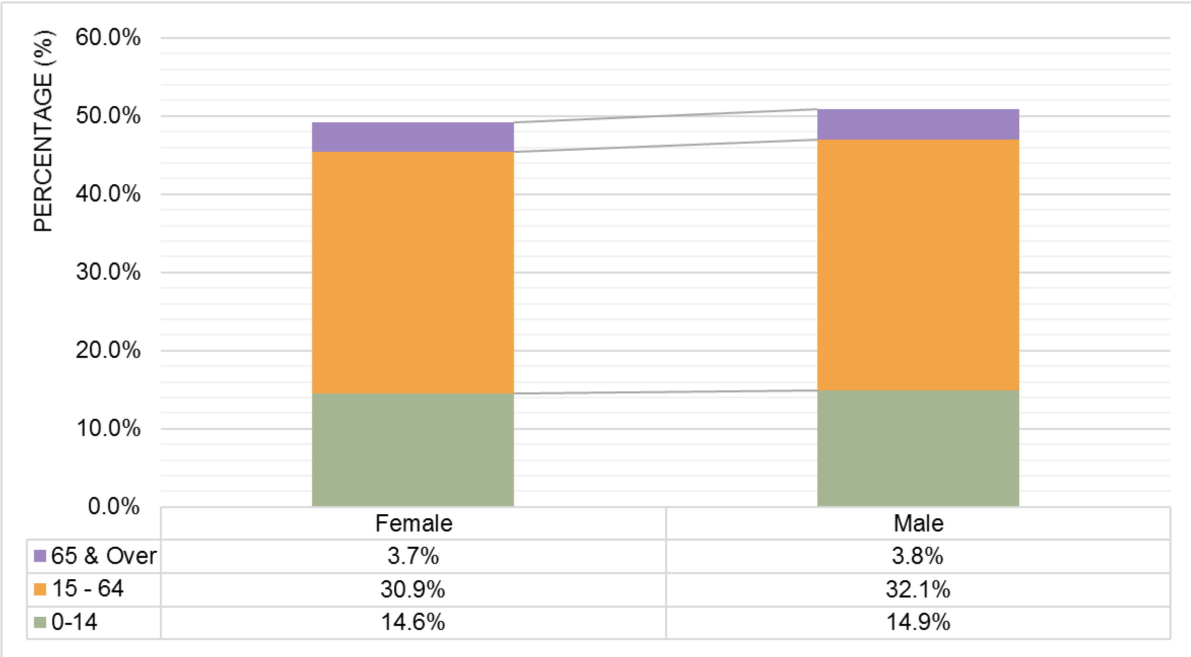
The segment of a population that is considered more vulnerable are the young (children less than five years old) and the elderly (65 years and over). In the SIA population, 9.6% comprised the vulnerable young category, and 7.5% comprised the elderly. Table 3-41 shows the percentage composition of each age category of the population. This is compared on a national, regional and local (SIA) level. Percentage age distribution in the SIA for the 0-14 years' age cohort (29.4%) is comparable to the regional figure for Hanover (28.4%). As mentioned preciously, elderly persons aged 65 years and greater make up 7.5% of the SIA population; and this value is also comparable to the regional figure for Hanover (7.3%). Within the SIA, the 15-64 years' age category accounted for 63.0% and can therefore be considered a working age population, similar to that for the nation (65.9%) (Table 6-53).

Table 6-53 Age categories as percentage of the population for the year 2011

Source: STATIN Population Census 2011

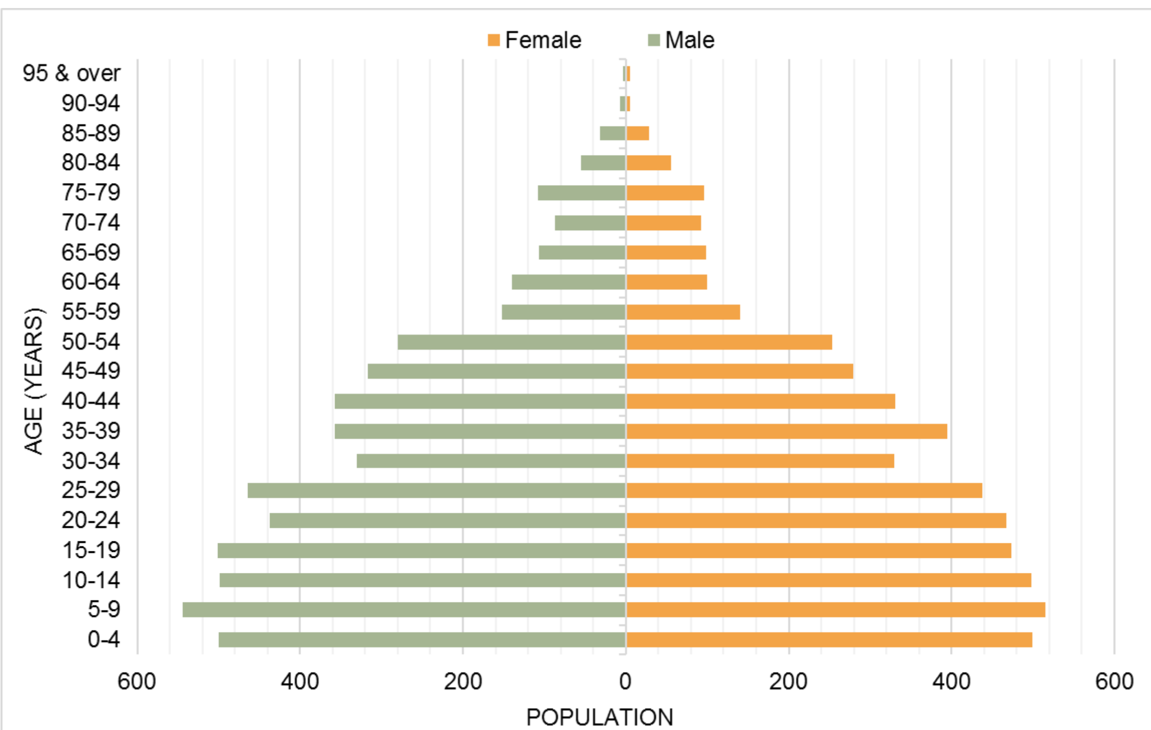
Age Categories	Jamaica	Hanover	SIA
0-14	26.1%	28.4%	29.4%
15 - 64	65.9%	64.2%	63.0%
65 & Over	8.1%	7.3%	7.5%

As seen in Figure 6-103, Census 2011 data indicated that there were slightly more males within each age cohort when compared to females. When these age groupings are further divided using a population pyramid (Figure 6-104), it is seen that the number of females are greater than males only in the 20-24, 55-39, 70-74 and 95&over year groupings. Sex ratio for all age cohorts within the SIA was calculated to be 103.5 males per one hundred females; this ratio however varies spatially across the SIA (Figure 6-105).



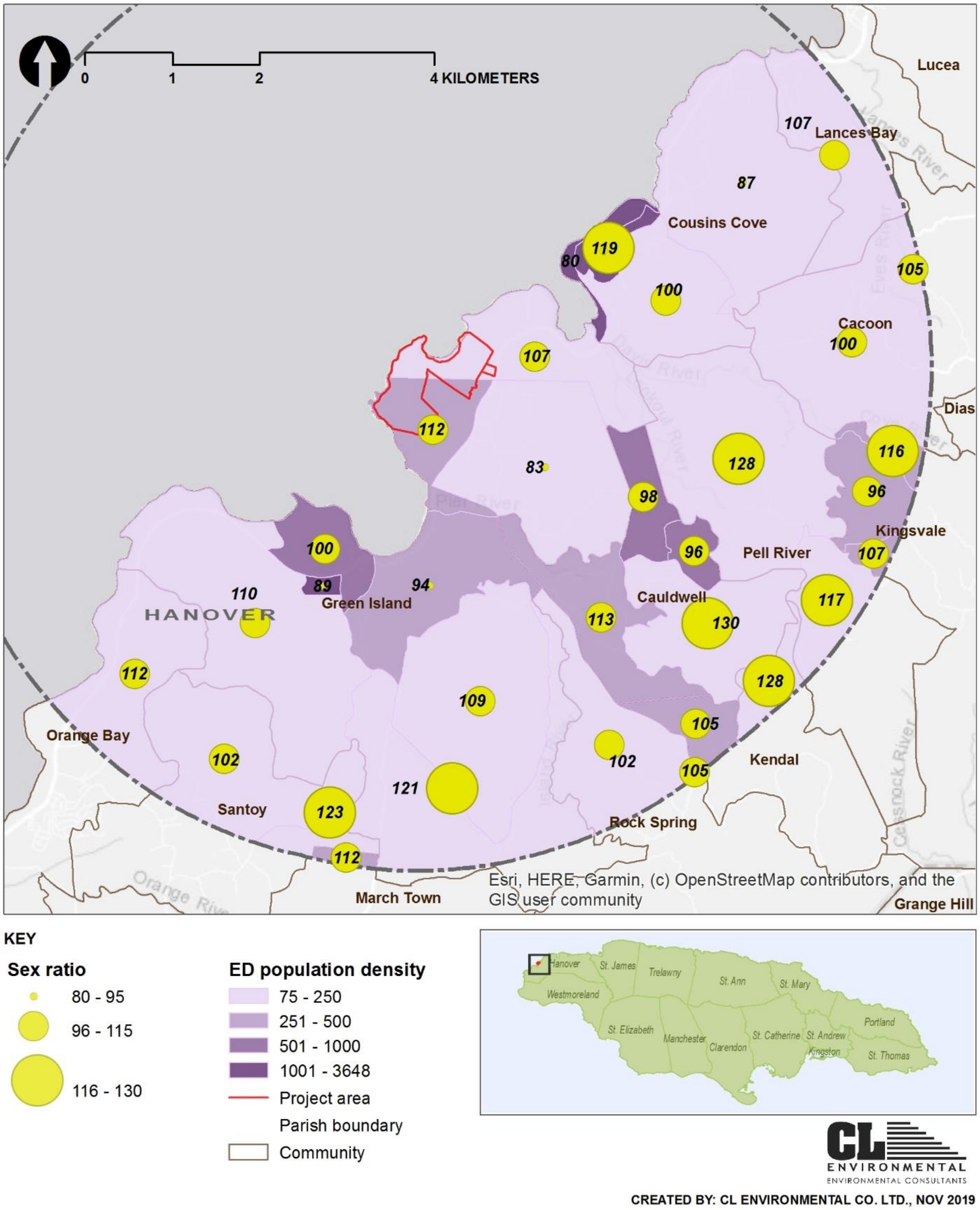
Source data: STATIN Population Census 2011

Figure 6-103 Male and female percentage population by age category in 2011 for the SIA



Source data: STATIN Population Census 2011

Figure 6-104 Population pyramid in 2011 for the SIA

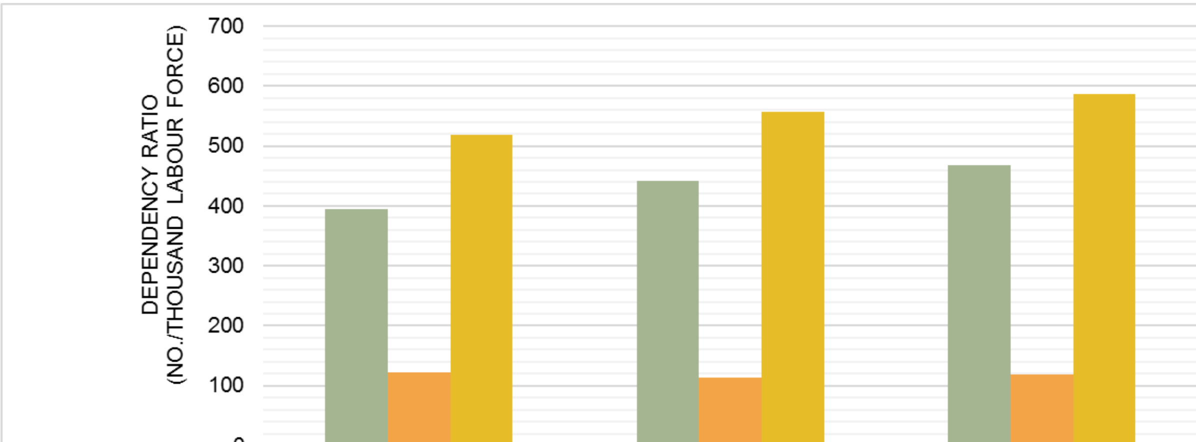


Source data: STATIN Population Census 2011

Figure 6-105 Sex ratio by ED within the SIA

6.7.2.3 Dependency Ratios

The child dependency ratio for the SIA in 2011 was 467.2 per 1000 persons of labour force age; old age dependency ratio stood at 119.2 per 1000 persons of labour force age; and societal dependency ratio of 586.4 per 1000 persons of labour force. This indicates that the youth (child dependency) are far more dependent on the labour force for support when compared with the elderly in the SIA. The SIA child and societal dependencies are higher than the figures for the parish of Hanover and island (Figure 6-106).



	Jamaica	Hanover	SIA
Child Dependency	395.4	442.4	467.2
Old Age Dependency	122.4	114.1	119.2
Societal Dependency	517.8	556.5	586.4

Source: STATIN Population Census 2011

Figure 6-106 Comparison of dependency ratios for the year 2011

6.7.3 Housing

6.7.3.1 Housing Units, Dwellings and Households

For the purposes of this study, the definition of housing unit, dwelling and household are those used in the population census conducted by the Statistical Institute of Jamaica (STATIN). The definition states that:

- A **housing unit** is a building or buildings used for living purposes at the time of the census.
- A **dwelling** is any building or separate and independent part of a building in which a person or group of persons lived at the time of the census". The essential features of a dwelling unit are both "separateness and independence". Occupiers of a dwelling unit must have free access to the street by their own separate and independent entrance(s) without having to pass through the living quarters of another household. Private dwellings are those in which private households reside. Examples are single houses, flats, apartments and part of commercial buildings and boarding houses catering for less than six boarders.

There were 3,634 housing units, 3,753 dwellings and 3,869 households within the SIA in 2011. The average number of dwellings in each housing unit was 1.0 and the average household to each dwelling was also1.0 (Table 6-54). The average household size in the SIA was 2.7 persons/ household. Comparisons of the SIA with national and regional ratios indicate that the SIA had comparable household/dwelling, average household size and dwelling/ housing unit ratios.

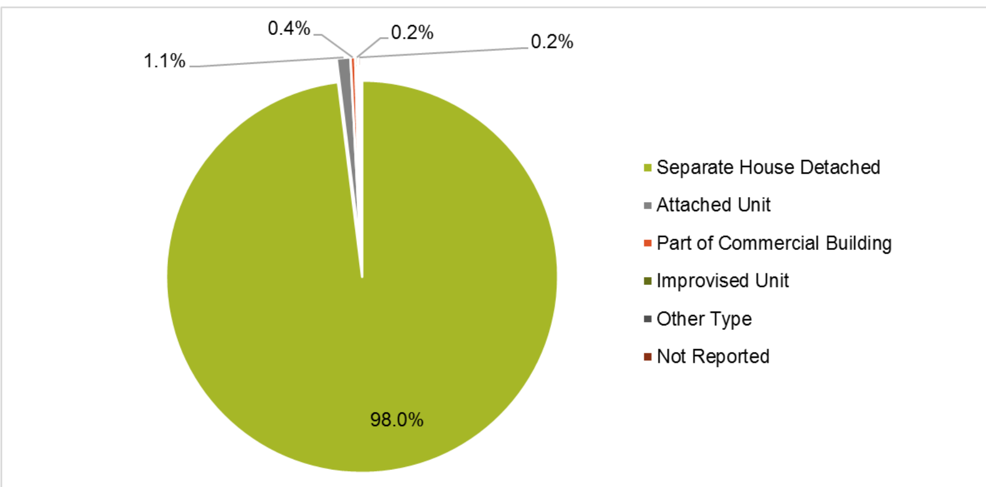
Table 6-54 Comparison of national, regional and SIA housing ratios for 2011

Source: STATIN Population Census 2001

	Jamaica	Hanover	SIA
Dwelling/Housing Unit	1.2	1.1	1.0
Household/Dwelling	1.0	1.0	1.0
Average Household Size	3.1	2.9	2.7

6.7.3.2 Housing Unit Type

Approximately 98.0% of the housing units in the SIA were of the separate detached type, 1.1% were attached, 0.4% part of a commercial building, 0.2% improvised unit and another 0.2% not reported (Figure 6-107).

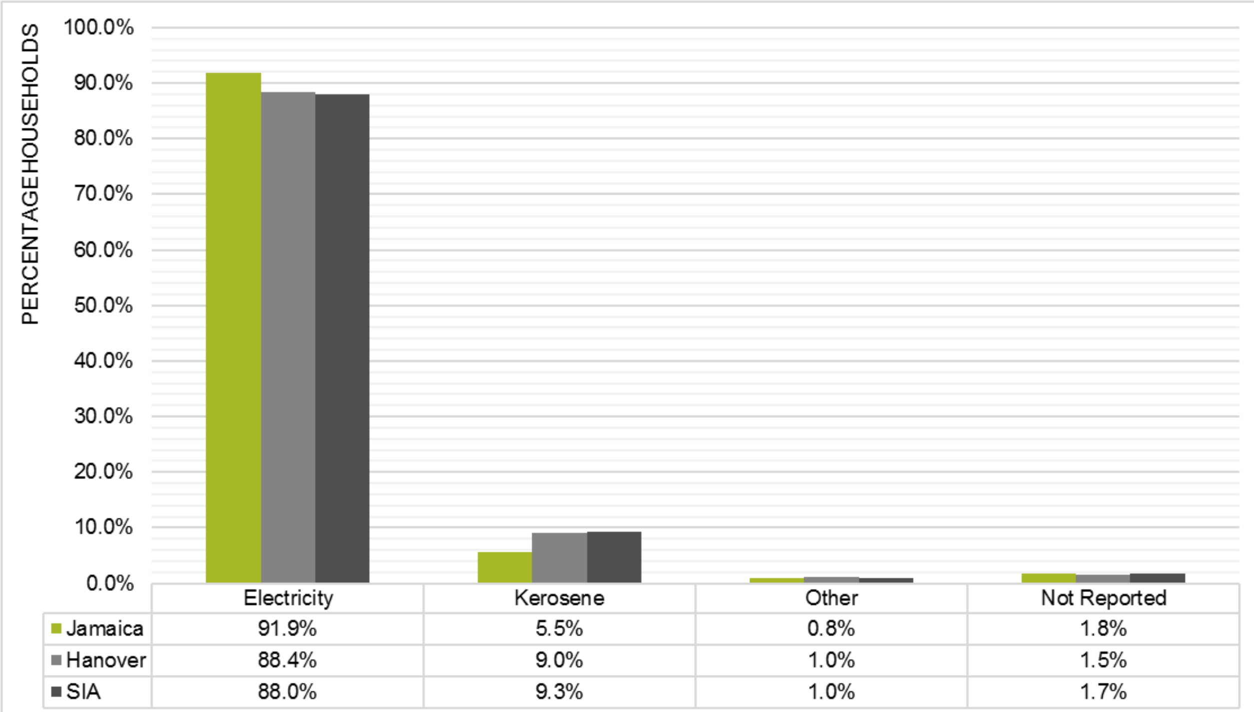


Source: STATIN Population Census 2011

Figure 6-107 Percentage of housing units by type within the SIA

6.7.3.3 Lighting

Figure 6-108 details the percentage of households using a category of lighting. Data for all extents (SIA, parish and national) reveal that most of the population utilises electricity as their main source of lighting. Approximately eighty-eight percent (88.0%) of households within the SIA use electricity, with kerosene being the secondary source of lighting within the SIA.



Source: STATIN Population Census 2011

Figure 6-108 Percentage households by source of lighting

6.7.3.4 Domestic Water Supply

The National Water Commission (NWC) is the public agency responsible for providing Jamaica's domestic water supply. The majority of the households within the SIA (80.6%) received their domestic water supply from a public source; this is similar to other extents investigated that had the majority of the population's water supply from a public source (Table 6-55).

Table 6-55 Percentage of households by water supply for the year 2011

Source: STATIN Population Census 2011

	Category	Jamaica	Hanover	SIA
Public Source	Piped in Dwelling	49.7%	43.5%	45.3%
	Piped in Yard	16.5%	17.5%	26.3%
	Standpipe	7.1%	14.2%	7.8%
	Catchment	2.2%	1.3%	1.1%
Private Source	Into Dwelling	6.4%	3.5%	1.7%
	Catchment	9.8%	7.7%	5.7%
	Spring/ River	3.0%	4.3%	2.1%
	Trucked Water/Water Truck	2.1%	2.8%	2.3%
	Other	1.8%	3.5%	5.5%
	Not Reported	1.3%	1.6%	2.1%

Water demand for the SIA in 2019 is estimated to be 2,612,871 litres/day (~690,248 gals/day) and is expected to increase to 3,603,706 litres/day (~951,998 gals/day) over the next twenty-five years based on population growth rates calculated previously.

6.7.3.5 Wastewater Generation and Disposal

It is estimated that approximately 2,090,297 litres/day (~552,198 gals/day) of wastewater is generated within the study area (for 2019) and is expected to increase to 2,882,964 litres/day (~761,599 gals/day) over the next twenty-five years based on calculated growth rates.

Census 2011 data for wastewater disposal methods was not available.

6.7.3.6 Solid Waste

It is estimated that at the time of this study (2019), approximately 17,624 kg (~18 tonnes) of solid waste was being generated.

The National Solid Waste Management Authority (NSWMA) is responsible for domestic solid waste collection within the study area and specifically, WPM Waste Management Ltd. covers the parish of St. Hanover. In residential areas, garbage is collected once per week. This service is provided free (partial covered by property taxes) for the households within the area.

6.7.4 Education

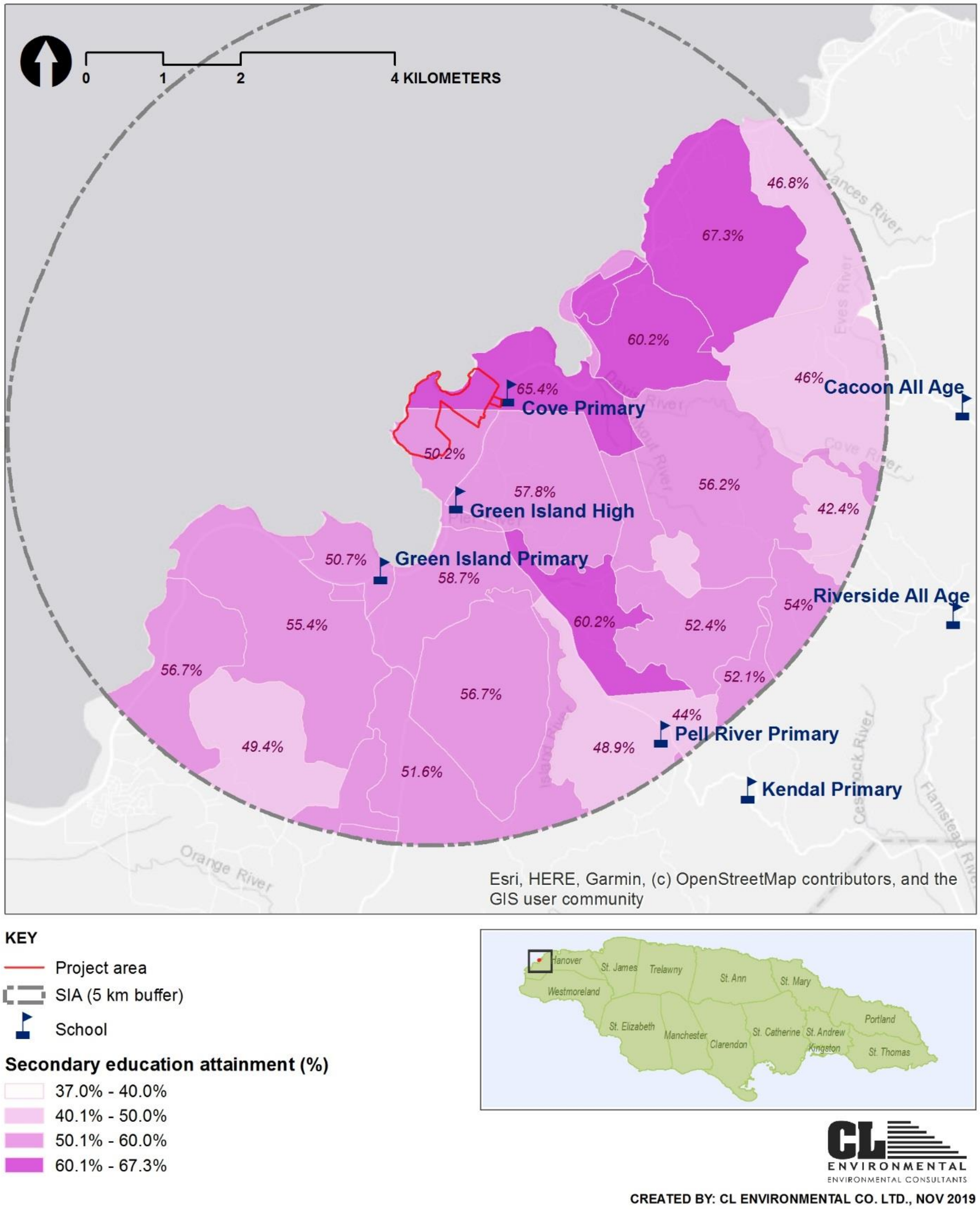
For 2011, the highest level of educational attainment for the national, regional and SIA extents are represented in Table 6-56. When the highest level of educational attainment within the SIA is calculated as a percentage, it becomes evident that there is a propensity towards the attainment of primary and secondary education. Fifty-five percent (55.1%) of the SIA population attained a secondary school education as the highest level, followed by 32.8% attaining primary education. Tertiary education attainment (university and other) as the highest level of education is lower in the SIA (3.8%) when compared to Hanover (5.7%) and the island (9.9%). The relatively high proportion of the population in proximity to the project location attaining a secondary education suggests that the labour pool is relatively educated.

Table 6-56 Population 3 years old and over by highest level of educational attainment as a percentage for the year 2011

Source: STATIN Population Census 2001

	Jamaica	Hanover	SIA
No Schooling	0.7%	0.7%	0.7%
Pre-Primary	4.8%	5.4%	5.8%
Primary	34.4%	38.6%	32.3%
Secondary	45.7%	46.6%	55.1%
University	4.7%	2.0%	1.2%
Other Tertiary	5.2%	3.6%	2.6%
Other	0.5%	0.2%	0.1%
Not Stated	0.0%	2.8%	2.2%

Figure 6-109 depicts secondary education attainment within the SIA and the location of schools in proximity to the proposed development. A total of 4 schools are located within the demarcated SIA: Cove Primary; Green Island High; Green Island Primary; and Pell River Primary.

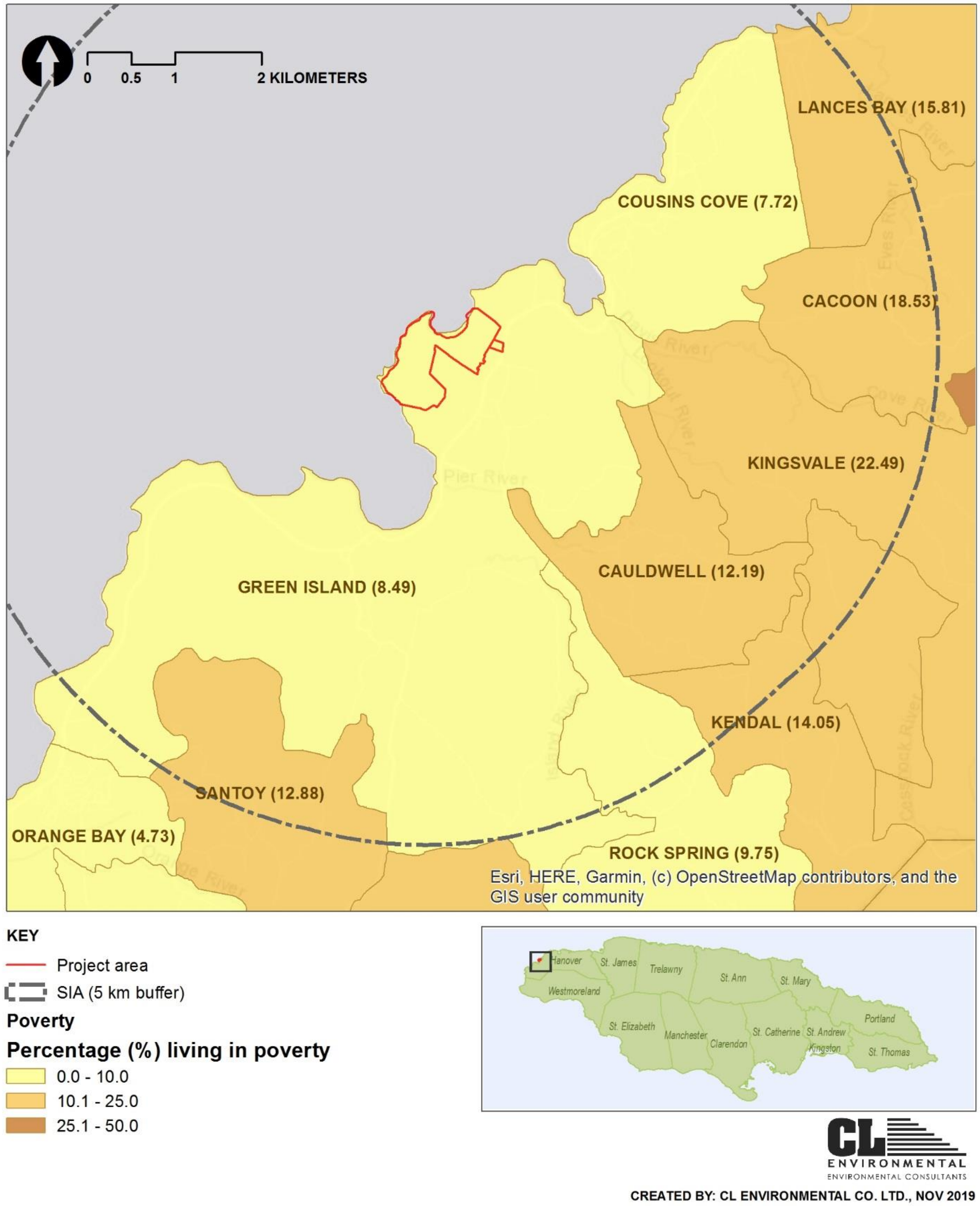


Source: Education (STATIN Population Census 2011), Schools (MGI and SDC)

Figure 6-109 Percentage population attaining a secondary education within the SIA

6.7.5 Income and Poverty

The poverty GIS dataset developed by the Planning Institute of Jamaica (PIOJ) (with contributions from STATIN, Social Development Commission (SDC) and the University of Technology), primarily identifies areas of poverty by community. Indicators utilized were those that best predicted per capita consumption levels in households based on data from the Jamaica Survey of Living Conditions (JSLC) 2002. Relevant variables that were common to this survey and the Population Census 2001 were selected and tested for similarity. Members of households that had consumption levels below the poverty line for the region in which their household was located were deemed to be in poverty. The proportion of persons in poverty in each community was used to rank the 829 communities. As seen in Figure 6-110, the community poverty level in Green Island is 8.49%.



Data source: PIOJ (with contributions from STATIN, SDC and the University of Technology

Figure 6-110 Proportion of persons in poverty in each community within the SIA

6.7.6 Infrastructure and Services

6.7.6.1 Telecommunication

The study area is served with landlines provided by Flow Jamaica Limited (formerly LIME Jamaica Limited). Wireless (mobile) communication is provided by Digicel Jamaica Limited and Flow and a network to support internet connectivity is also provided by Flow.

6.7.6.2 Health and Emergency

Health Centres

One health centre exists within the SIA (Figure 6-111),namely Green Island Health Centre, which is a Type 3 Health Centre falling under the responsibility of the Western Regional Health Authority (WRHA). A Type 3 Health Centre is the headquarters of the Health District and may serve a population of 20,000 people through a number of types 1 and 2 Health Centres.

Hospitals

No hospitals are located within the SIA. Noel Holmes Type C Hospital is found in Lucea, approximately 10.5 km northeast of the project. Type C hospitals provide primary care services and basic secondary care services.

Fire Stations

Fire stations are not found within the SIA (Figure 6-111). Fire stations island-wide are served by a fleet of 91 operational firefighting and rescue vehicles and 58 utility vehicles. There are also 3 fire boats, one each assigned to the harbours in Kingston, Montego Bay and Ocho Rios. The Fire Prevention and Public Relations Division and the Emergency Medical Service (EMS) provide fire prevention services and emergency medical rescue/ paramedic services (Jamaica Fire Brigade , 2012). The station that would respond to any eventualities at the proposed Project site would be the one located at Lucea, which is about 14 km east of the site. This station has 1 pumper and, in the event, that backup is needed, this backup would be from the station in Negril which is approximately 30 minutes west of the proposed site. It too has 1 pumper truck.

Police Stations

The Green Island Police Station exists within the SIA, approximately 2 km south of the project land. Crime in the area is low.

Data source: Health centres, police stations (Social Development Commission, 2019); hospitals, fire stations (Mona GeoInformatics Institute)

Figure 6-111 Health and emergency services located in and around the SIA

6.7.6.3 Transportation

Ground Transportation

An overview of the existing road network within the SIA may be found in Figure 6-112. Several modes of ground transportation to and from communities in the SIA exist and include taxi (licensed & unlicensed), bus, private motor car, motorcycle, and bicycle.

The North Coast highway (a two-lane road from Negril to Port Antonio passing through the towns of Lucea, Montego Bay and Ocho Rios) runs approximately 400m south of the proposed hotel development. It takes approximately 40 minutes to an hour to get to Montego Bay and approximately 30 to 40 minutes to Negril travelling along the highway.

Airfields, Aerodromes and Airports

Airfields or airports are not situated within the SIA. The closest facility is Negril Aerodrome, approximately 9.5 km southwest of the project. The Sangster International Airport, located 38 km northwest of the project, is the leading tourism gateway to the island of Jamaica and is the larger of two international airports in Jamaica. Approximately 95% of total passengers at this airport are passengers travelling internationally and of the approximately 1.7 million annual visitors to Jamaica, 72% use this airport as their primary airport. Peak arriving and departing capacity is 4,200 passengers per hour (MBJ Airports Limited, 2016).

Figure 6-112 Existing transportation within the SIA

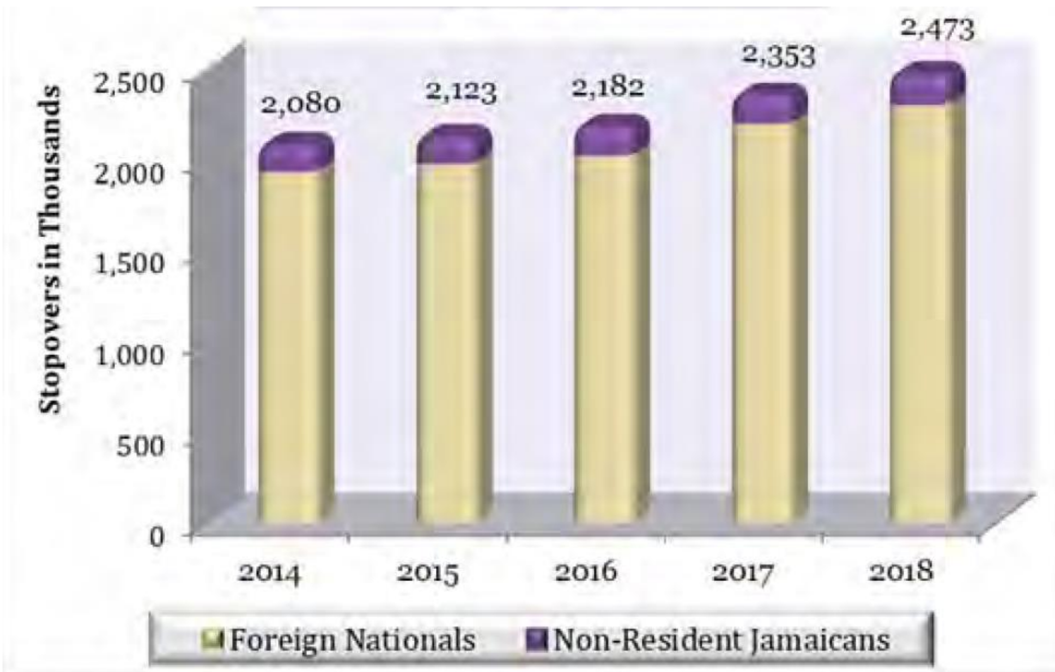
6.7.7 Industrial and Economic Activity

6.7.7.1 Tourism

Information provided in this section is taken from the *Annual Travel Statistics 2018* (Jamaica Tourist Board, 2018).

Stopover Arrivals

Total stopover arrivals for the year 2018 reached another record of 2,472,727, which was 5.1% above the 2,352,915 arrivals recorded in 2017. This figure represents 119,812 more stopovers than in 2017 (Figure 6-113).



Source: (Jamaica Tourist Board, 2018)

Figure 6-113 Stopover visitors to Jamaica 2014 – 2018

Cruise Passengers

Jamaica recorded a decrease in cruise passengers during 2018 from. This total of 1,845,873 cruise passengers, who visited our shores, was a 4% decrease over the 1,923,274 recorded for the corresponding period in 2017. The port of Montego Bay accounted for 512,563 passengers or 27.8%.

Hotel Accommodations

The average available room capacity rose by 4.7% in 2018, 22,553 rooms in 2017 to 23,615 rooms in 2018. Total room nights sold of 5,767,196 in 2018 was up 7.9% above the 5,344,335 room nights sold in 2017 (Figure 6-114). Hotel room occupancy increased by 2.0 percentage point to 66.9%, compared to the 64.9% level in 2017. In the resort region of Montego Bay, the annual hotel room occupancy rate was 68.7%, which was up by 0.4% from the 68.3% recorded in 2017. The total number of room nights sold increased by 4.1% moving from 2,233,331 in 2017 to 2,326,005 in 2018.

Source: (Jamaica Tourist Board, 2018)

Figure 6-114 Hotel room occupancy (percentage) by resort area for 2017 and 2018

Visitor Expenditure

Gross visitor expenditure in 2018 was estimated at approximately US$3.305 billion. This represents an increase of 9.8% against the estimated US$3.010 billion earned in 2017. Total expenditure of Foreign Nationals amounted to US$3.027 billion. Cruise passenger expenditure totalled US$0.184 billion while US$0.094 billion was estimated as the contribution of Non-Resident Jamaicans. Foreign Nationals spent on the average US$162.12 per person per night while cruise passengers spent an average of US$100.47 per person per night.

Direct Employment in the Accommodation Sector

The number of persons employed directly in the accommodation sub-sector moved from 48,439 in 2017 to 50,416 in 2018, an increase of 4.1%. The main resorts of Montego Bay, Ocho Rios and Negril accounted for 45,289 persons or 89.8% of the total number of persons employed directly in the accommodation subsector (Montego Bay with 22,081 direct jobs represented 43,8% of those employed). The average number of employees per room in 2018 was estimated at 1.54 (Jamaica Tourist Board, 2018).

6.7.7.2 Fishing Beaches

Four (4) fishing beaches exist within approximately 5 km of the project area (Figure 6-115). These are:

- Orange Bay (18F)
- Green Island (19F)
- Cousins Cove (20F)
- Lances Bay (21F)

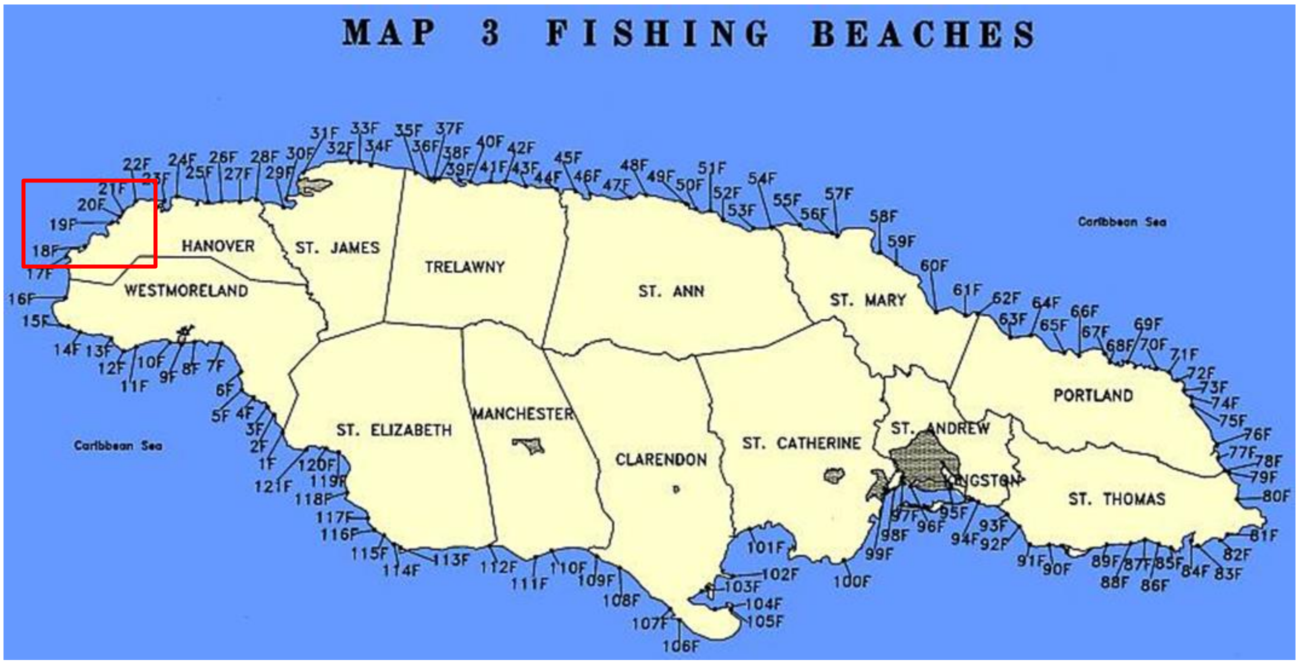


Figure 6-115 Map of fishing beaches within 5 km of proposed project site (in red square)

6.7.7.3 Public Beaches

Table 6-57 shows a list of all the public bathing beaches in Hanover. Only Lances Bay falls within 5 km of the proposed project site.

Table 6-57 Public bathing beaches in Hanover

LOCATION	OWNER/AGENCY IN POSSESSION
Bloody Bay	UDC
Lances Bay	**Hanover Municipal Corporation**
Bulls Bay	Hanover Municipal Corporation
Watson Taylor Park	Hanover Municipal Corporation
Tryall	BCA/NRCA
Orchard	

6.7.8 Land Use

6.7.8.1 Historic Land Use

According to the Jamaica National Heritage Trust (Section 6.5.2.1), a number of sugar estates existed during the 18th century namely Cove, Industry, Harding Hall, Spring Valley, Haugton Hall, Pell River, Caudwell, Saxham and Green Island. The surrounding estates produced sugar. Cove produced sugar by an animal mill in 1763. In the early 20th century Coconut, Naseberry and Oranges were planted but most have not survived.

6.7.8.2 Existing Land Use

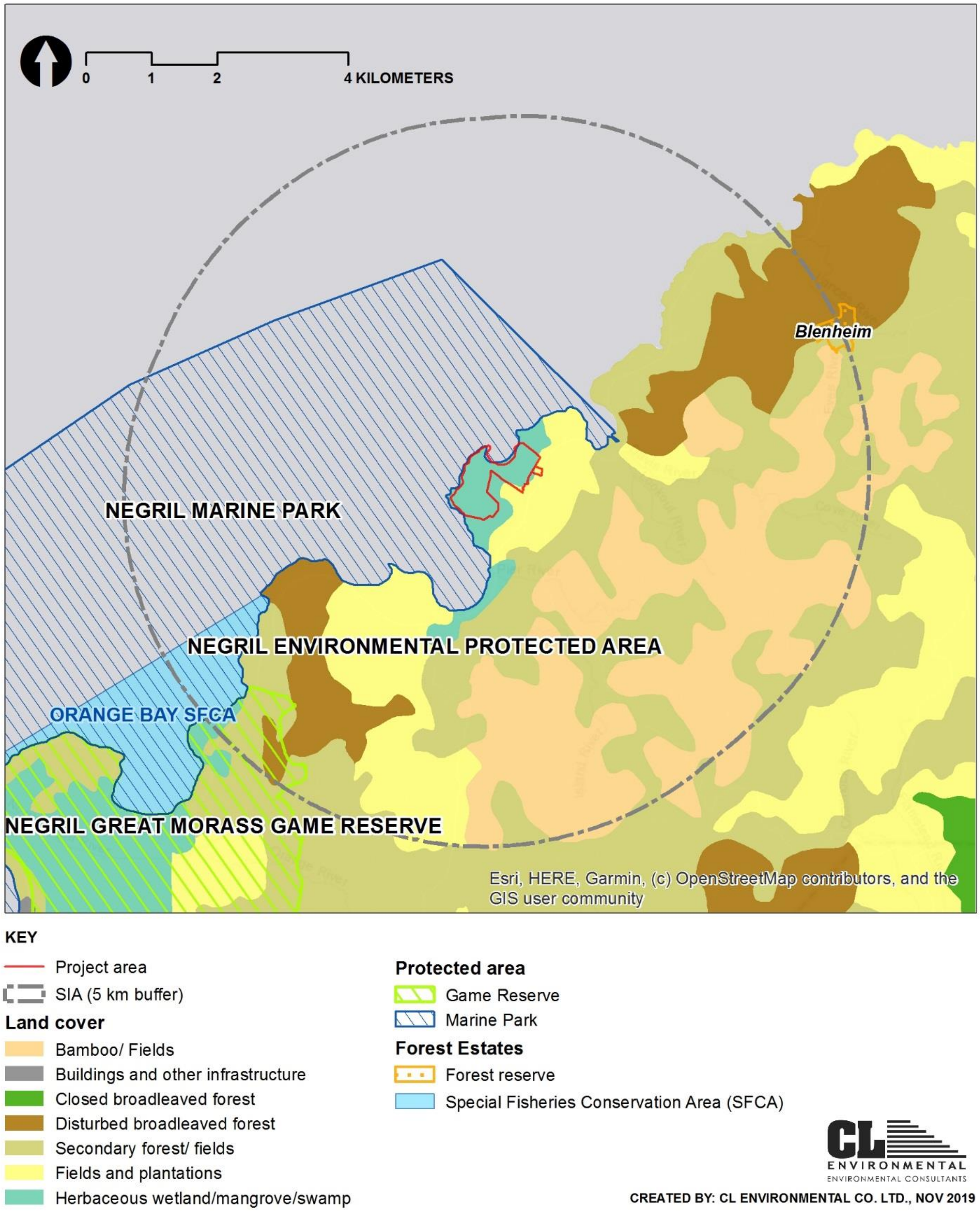
Within the greater study area, land cover is mixed; Figure 6-116) shows the spatial outlay of the main land cover areas:

- Bamboo and Fields
- Buildings and other infrastructures
- Fields and Secondary Forest
- Closed and Disturbed broadleaf forest
- Fields: Herbaceous crops, fallow, cultivated vegetables
- Plantation: Tree crops, shrub crops, sugar cane, banana
- Mangrove forest

Other land use activities observed on site during fieldwork activities include:

- Charcoal burning – evidence included old burning spots
- Bird shooting – shotgun shell casings observed on the ground (Plate 6-68)
- Boat docking – fishing boats observed on shoreline
- Bee farming – bee boxes observed (Plate 6-69)

According to Mr. Jack English (local guide from the area accompanying JNHT), residents from Cove would walk to beach to swim, have picnics and sometimes host beach parties.



Data sources: Protected areas (NEPA and MGI), land cover (Forestry Department, 1998) modified using satellite imagery shown on map.

Figure 6-116 Land use, forest estates and protected areas within the SIA

Plate 6-68 Shotgun shell casings on property showing evidence of bird shooting activities

Plate 6-69 Bee boxes on property showing evidence of bee farming activities.

New Developments 2019

Airlift

- Delta Airlines began new operations out of New York (JFK) into Norman Manley International Airport.
- Frontier Airlines began new services out of Philadelphia Pennsylvania (PHL) and Raleigh North Carolina (RDU), into Sangster's International Airport.
- Spirit Airlines began new services from Orlando Florida (MCO) into both International Airports; and from Detroit (DET) into Sangster's International Airport.
- Southwest Airlines began a new service out of St. Louis, Missouri (STL) into Sangster's International Airport.
- New Chartered services were offered from Sun Country Airline from Dallas Ft. Worth Texas (DFW) and Thomas Cook out of Manchester England (MAN). ** Thomas Cook entered compulsory liquidation on 23 September 2019.*

Accommodations

- The R Hotel, Kingston's first Extended stay / Apartment Hotel opened with 58 rooms.
- "S" Hotel, the former Breezes Montego Bay, after extensive refurbishing opened with 124 rooms in January 2019.
- AC Hotel Kingston by Marriot with 220 completed construction and opened in June 2019.
- The Half Moon resort has rebranded its villas as the Rose Hall Villas, began construction of 57 additional new rooms scheduled for completion November 2019.
- Ocean Coral Spring by H10 Hotels Trelawny, Silver Sands began construction on the first phase of an exclusive Caribbean resort, with 500 rooms expected to be completed by December 2019.
- The former Oceana Hotel is expected to undergo refurbishing and will form part of the Hilton Tapestry brand to be named the ROK Hotel. This 12-storey hotel will operate 168 rooms on the downtown Kingston waterfront.

Future developments include construction of;

i. The National Housing Trust (NHT) Industry Cove Manor, Industry Cove, Hanover – 63 units
ii. Selective Homes Winchester Housing Development Phase 2, Green Island, Hanover – 330 units
iii. Infinite Houses Ocean Pointe Development, Point, Hanover – 435 units

6.7.8.3 Protected Areas and Zoning

Protected areas examined here include all areas of land or water protected by various laws in Jamaica, as well as international agreements, that fall within or in proximity to the project area; these include fish sanctuaries or Special Fishery Conservation Areas (SFCAs), protected areas (declared and proposed), national parks, forest reserves, marine parks, game reserves and national heritage and monuments. Figure 6-116 shows the location of protected areas in relation to the project; the following protected areas fall entirely or partially within the SIA:

- Negril Environmental Protected Area
- Negril Marine Park
- Negril Great Morass Game Reserve
- Orange Bay SFCA

Negril Environmental Protected Area

As seen in Figure 6-117, the proposed project area falls within northern-most section of the protected area boundary. The Environmental Protection Plan establishes the goals of the Negril EPA and guides environmental planning and decision making within the area.

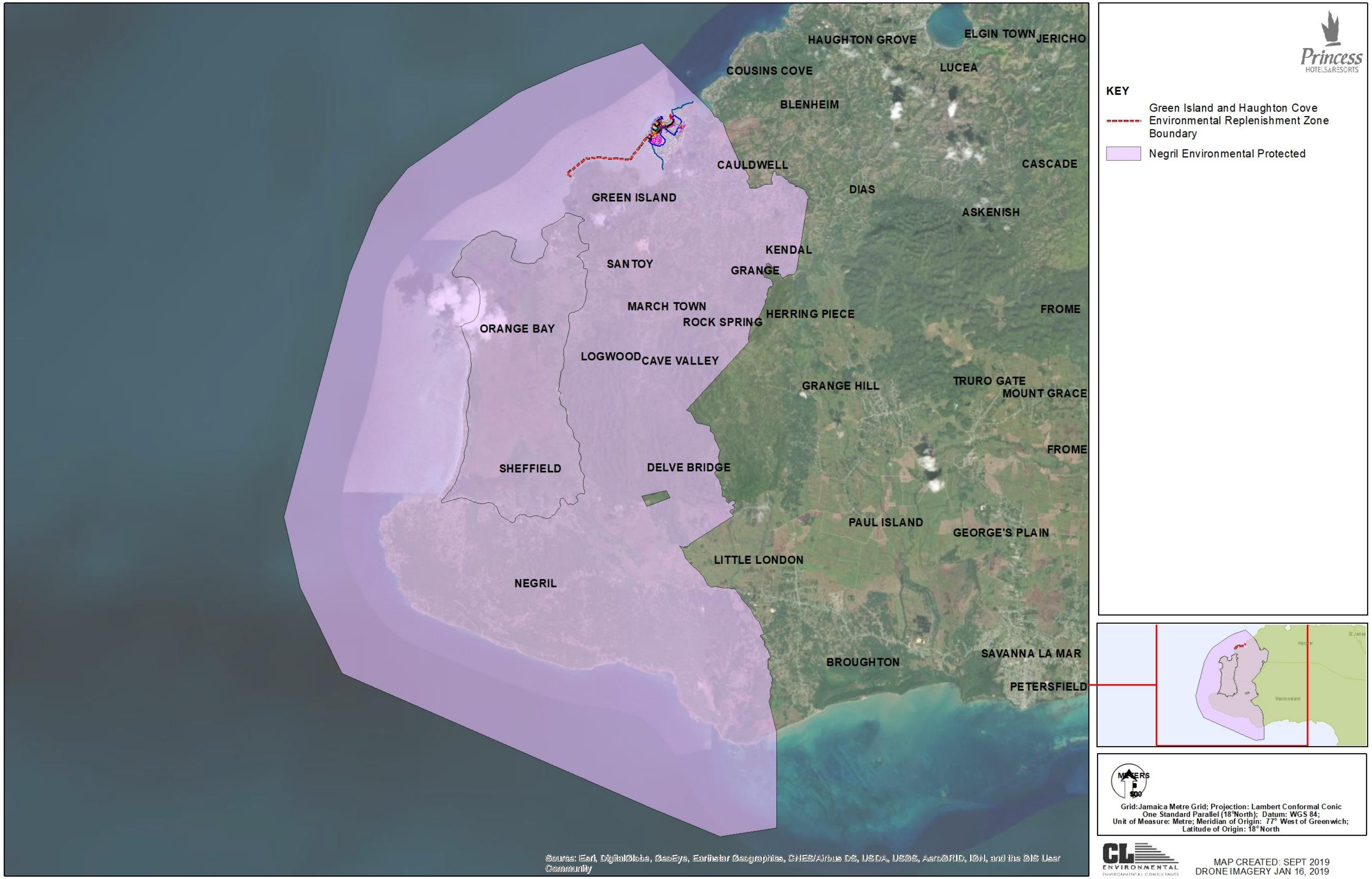
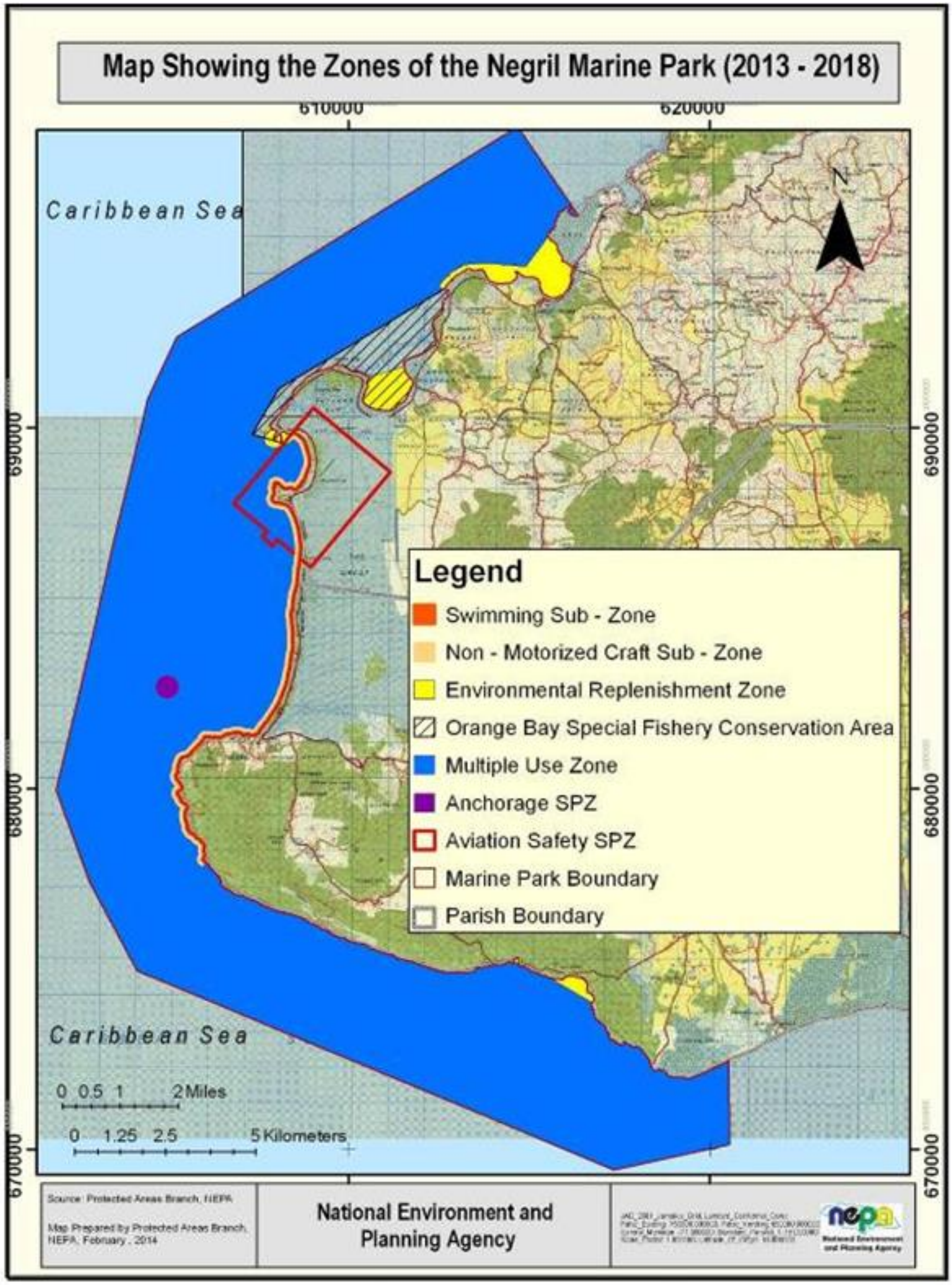


Figure 6-117 Negril Environmental Protected Area in relation to project site

Negril Marine Park

The Negril Marine Park covers a total area of approximately 160 km^2 and extends from the Davis Cove River, Hanover to St. John's Point in Westmoreland. The proposed project site is in the vicinity of the Negril Marine Park and Figure 6-118 shows the following main zones within the area:

i. Swimming
ii. Non-motorized
iii. Motorized
iv. Replenishment
v. Diving
vi. Multiple-use



Source: Negril Marine Park Zoning Plan 2017 - 2022

Figure 6-118 Map showing the zones of the Negril Marine Park (2017-2022)

Negril Great Morass Game Reserve

The Royal Palm Reserve is located in the Great Morass was one of the biggest Eco-tourism attractions in Jamaica. It was developed during the mid- 1980's as part of a proposal for mining peat in the Negril Great Morass. The area is home to many examples of the morass Royal Palm (*Roystonea princeps*), a species which is endemic to the area. Today, one hundred and fourteen (114) plant species including one of the largest stands of Royal Palms in the world and over three hundred (300) animal species, such birds, butterflies and reptiles can be found at the reserve. [6]

Orange Bay SFCA

The Orange Bay Special Fishery Conservation Areas (SFCA) was declared an SFCA on July 28, 2009 and is managed by Negril Environmental Protection Trust (NEPT). The SFCA is approximately 535 hectares in area (Figure 6-119).

Special Fishery Conservation Areas (SFCA) are no-fishing zones reserved for the reproduction of fish populations. Their nature reserve statuses are declared by the Agriculture Minister under Orders privileged through Section 18 of the Fishing Industry Act of 1975. It is, therefore, illegal and punishable by law to engage in any unauthorized fishing activities in the demarcated zones. The SFCAs are anticipated to gradually increase fish populations affected by overfishing, habitat degradation and land-based non-point source pollution, among other stressors. The SFCA habitats provide the marine species the opportunity to reach full sexual maturity therefore increasing their egg producing/spawning potential and survival of the species overall.

SFCA's also offer socio-economic benefits, in terms of:

- Improving economic opportunities for fishers as the catch per unit effort for fishermen should increase within the areas surrounding the reserves.
- Increased opportunities for eco-tourism, allowing visitors and citizens to view our tropical fish species in their natural environment.
- Providing environments for further research and development initiatives

Source: https://www.micaf.gov.jm/sites/default/files/Special_Fisheries_Conservation_areas.pdf

[6] http://www.jamaicatravelandculture.com/destinations/westmoreland/negril/royal-palm-reserve.htm

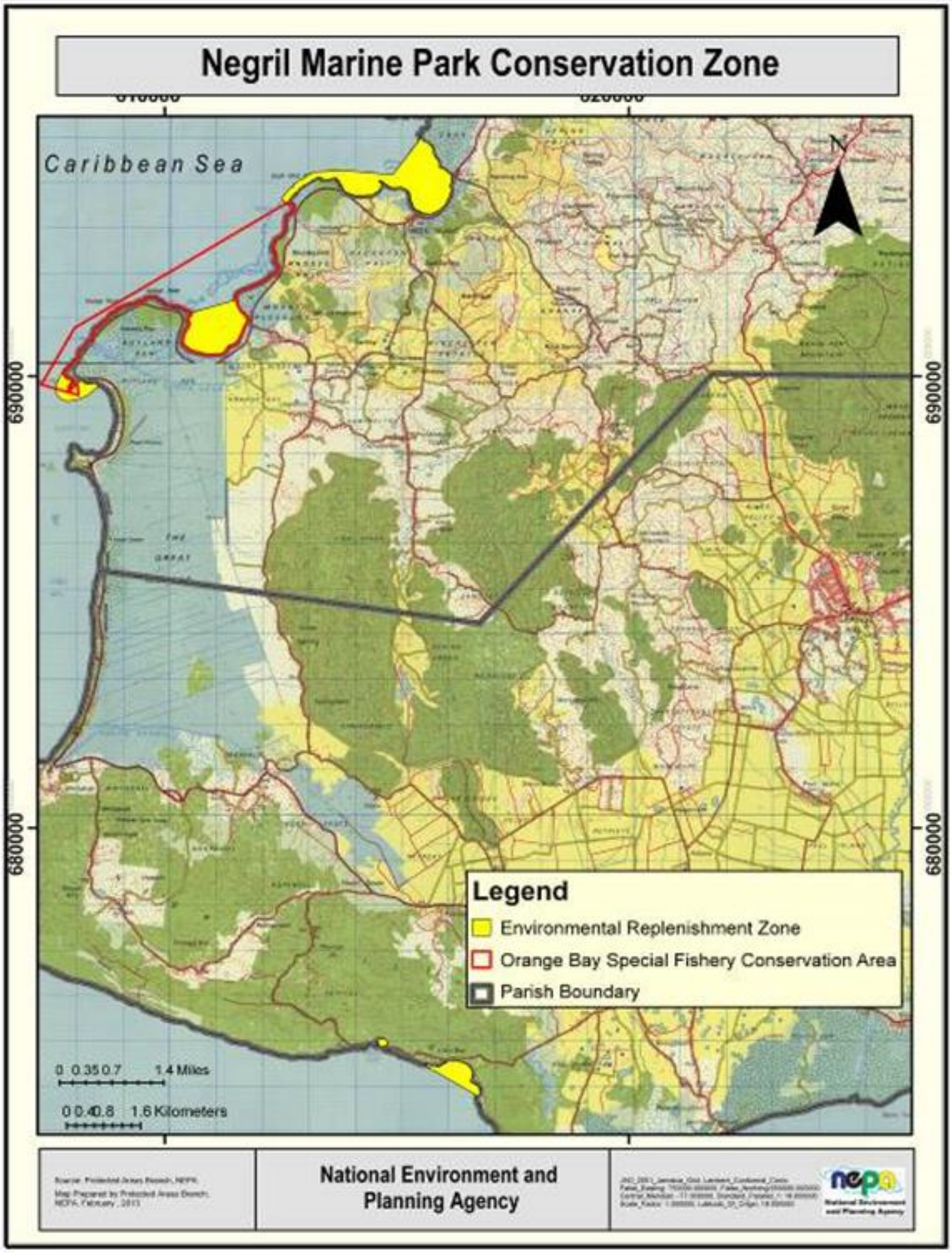


Figure 6-119 Boundaries of the Orange Bay SFCA

6.7.8.4 Forest Estates

Forest Estates collectively encompass three descriptive types:

1) Forest reserves – Government and privately-owned lands that have been gazetted as Forest Reserves;
2) Forest Management Areas - Probate lands co-managed by the Forestry Department and gazetted as Forest Management Areas); and
3) Crown Lands - Lands transferred to the Forestry Department for management by the Commission of Lands).

Of particular interest are Forest Reserves, which are considered protected areas; one forest estate Blenheim, is partially located within the SIA (Figure 6-116) (Forestry Department, 2011).

6.7.8.5 Zoning

According to the Negril and Green Island Provisional Development Order, 2013 (Figure 6-120), within the greater study area, the various zones identified include:

- Conservation
- Resort/Residential
- Residential Single Family
- Residential/Agriculture
- Agriculture
- Mixed Use

The proposed project area is zoned for conservation.

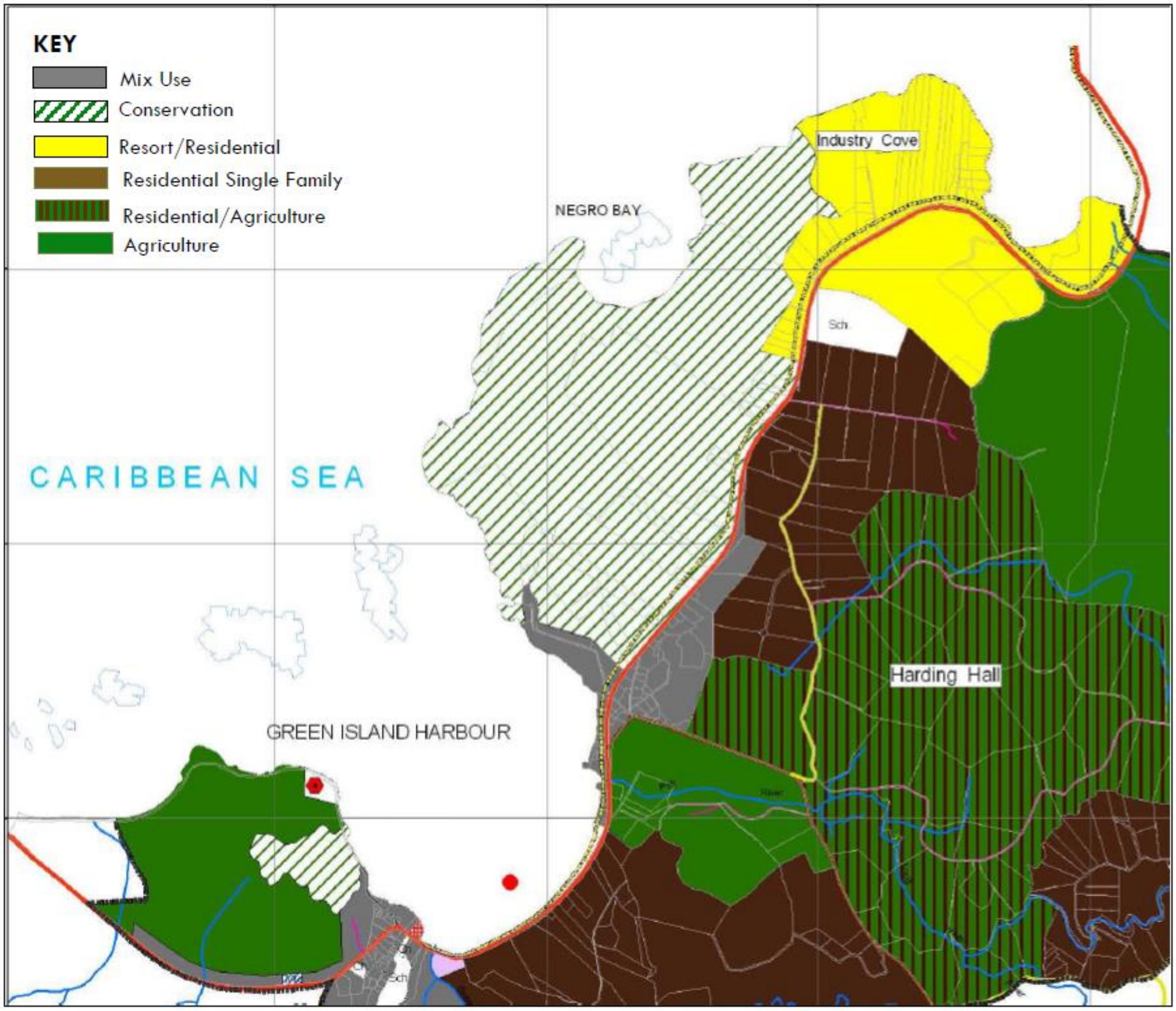


Figure 6-120 Zoning according to the Negril and Green Island Provisional Development Order 2013

7.0 PUBLIC PARTICIPATION

7.1 PERCEPTION SURVEY

7.1.1 Methodology

The sample size was determined by using the Raosoft sample size calculator set at 95% confidence level based on the population within the SIA. Using this we determined the sample size by ratios in each Enumeration District (ED). Teams of persons then administered the required number (determined by the calculator at 95% confidence level) of questionnaires randomly within each ED.

7.1.2 Community

During the period October 24, 25, 26, 28 and 30, 2019 a total of three hundred and twenty four (324) questionnaires were administered, of which three hundred (300) were administered in the communities questionnaires and twenty-four (24) questionnaires specifically targeting fishers were administered within a five-kilometre radius of the proposed site for the construction of the Princess Hotels Resorts hotel in the Cove area of Hanover. Examples of the questionnaires can be seen in Appendix 6.

Just over Fifty-six percent (56.3%) of respondents were male while 43.7% were female.

Of the Three Hundred (300) respondents age cohort distribution was as follows; 14.7% were 18-25 years of age, 20.3% were 26-33 years, 24.7% were age 34-41 years, 20.3% were age 42-50 years, 11.7% were age 51-60 years and 8.3% were older than sixty years of age.

Respondents were from twenty main communities. These communities were Green Island (19.7%), Industry Cove (12.0%), Cousins Cove (10.3%), Santoy (9.0%), Cauldwell (7.3%), Davis Cove (3.0%), Spring Valley (3.7%), Spring Mountain (2.3%), Woodchurch (5.0%), Friendship (1.7%), Pell River (2.3%), Saxham (2.3%), Grange (5.7%), Prospect (4.7%), Harding Hall (3.7%), Abingdon/Haughton (1.2%), Haughton Hall (0.7%), Hatchwell (1.7%), Salt Spring (2.0%) and Rhodes Hall (1.7%).

Based on the most recent population census data, a total survey number of 373 would have represented a 95% confidence limit. However, this number was not accomplished. Reasons being:

- The demography of the survey area has changed over the years. During the field exercise it was observed that the landscape of some communities has changed since the last population census as some communities no longer have large populations while some communities which were once small (based on census data) have grown over the years. This was most noticed in the Davis Cove and Rhodes Hall areas. Population census data suggested that these communities should be well populated; however, during the survey exercise, not many residences were observed.
- Incidences of crime and violence and alleged lottery scamming activities in some communities prevented the survey team from entering the areas. This was most noticed in the Santoy, Spring

Valley and Davis Cove and Cousins Cove communities. In an effort to interview residents from these areas, the survey team had to remain at a safe central location (e.g. a taxi stands or close to the main) and interview persons from these areas outside the community. Additionally, some survey instruments had to be administered remotely (e.g. by telephone).

- Communities thought to be discrete communities, were found to have significant overlap. This was most noticed in the Davis Cove, Cousins Cove and Industry Cove Communities, the Friendship and Pell River Communities and the Abingdon and Haughton Communities.

While, the ideal sample size was not reached, it is thought that the survey number of 300 is representative based on observed field conditions. For some communities in proximity, these have been merged and discussed together.

Percentages presented are for the total number of persons offering responses; in instances where respondents did not offer an answer to a question, they were not considered part of the analyses.

7.1.2.1 Results and Findings

Of those persons interviewed who offered a response (100.0%), 41.7% indicated that they were self-employed, while 41.3% stated that they had an employer and 12.0% stated they were unemployed. Approximately nine percent (5.0%) of individuals were retired. Additionally, 70.7% of interviewees when asked confirmed that they were the head of their household while 29.3% indicated that they were not the household head.

Regarding the number of persons residing in households, sixteen percent (16.0%) of households had one occupant while 22.3% had two occupants, 19.0% had three occupants while 18.0% had four persons living in the household. Twelve percent (12.0%) had five persons living in the household and 12.7% of households had more than five persons residing.

In general, interviewees resided in their communities over the long term. Fifty percent (50.0%) of individuals resided in their communities for all their life, and 16.7% resided in their community in excess of fifteen years. Approximately thirteen percent (12.7%) stated they lived in their community for between ten and fifteen years; 10.7% resided for between five and ten years. Just over six percent (6.2%) resided in their community for between three and five years and 3.7% for under two years.

On the issue of where healthcare was mostly obtained, 12.7% stated the public clinic, 48.3% stated the public hospital and similarly 48.3% stated that healthcare needs were mostly sourced through the private doctor. No one interviewed (0.0%) stated the private hospital. It should be noted that in some instances, respondents offered multiple responses regarding where they mainly went for healthcare, therefore percentages exceeded one hundred. As it pertained to the specific healthcare provider, the public hospital most referenced was the Noel Holmes Hospital as well as the Savanna-la-mar and Falmouth hospitals. It should be noted that while the Cornwall Regional Hospital was mentioned it was not a popular choice. This was most likely due to ongoing construction activities which have resulted in limited services being offered. As it pertained the public clinic, the Lucea Public Clinic was most referenced. It was also realised that respondents attended the public clinic within their community where one was present or visited the public clinic in closest proximity to their community of residence.

As it related to whether respondents suffered from specific medical conditions, 14.0% of interviewees indicated that they were asthmatic, 17.0% indicated that they suffered from sinusitis, 1.7% confirmed coughing as an ailment, while 1.0% indicated that they suffered from congestion/bronchial problems. Just over three percent (3.3%) indicated that they suffered from chest pains while 0.3% of those interviewed confirmed frequent bouts of diarrhoea. Approximately sixty-six (65.7%) percent of those interviewed indicated that they did not suffer from any of the specific conditions named. It should be noted that in some instances, respondents suffered from more than one of the listed ailments, therefore percentages exceeded one hundred.

Of those interviewed, just under twenty-three percent (22.7%) of respondents refused to offer a response relating to their personal weekly income. Eleven percent (11.0%) of persons indicated that they did not have a weekly income, while 1.7% indicated that their weekly income was under the previous national minimum wage of $6,200.00 per week. Approximately three percent (3.3%) of interviewees indicated that their weekly income was $6,200.00 per week; 19.3% stated that their weekly income was between $6,201.00-$10,000.00, while 33.0% stated a weekly income ranging between $10,001.00 and $20,000.00. Nine percent (9.0%) indicated that their weekly income was in excess of twenty thousand dollars ($20,000.00).

Regarding the highest level of education completed, all persons interviewed (100.0%) offered a response. Of this number less than one percent (0.7%) indicated that they did not attend school; 13.2% stated they completed primary/all age school, 9.7% stated that they did not complete high school, 59.7% completed high school, 2.7% college, 3.0% university and 11.0% HEART/Vocational Training Institution.

As it pertained to education, 56.7% of interviewees indicated someone in the household was attending school. As it related to the school being attended 27.6% stated that the school being attended was infant/basic, 55.3% stated primary/all age, 44.1% stated high school, 2.9% college 3.5% university and 4.1% HEART/Vocational Training Institute. It should be noted that percentages will exceed one hundred as multiple persons from households attend school.

When respondents were asked about the presence of recreational spaces in their community 66.7% of those offering a response indicated that a recreational space was present. In many instances, there was no established recreational space, the community instead has cleaned a maintained greenspace especially for the playing of community football (soccer). Recreational spaces named were:

- Haughton Community Centre (4.5%)
- Green Island High School Field (21.7%)
- Green Island Community Centre (7.1%)
- Santoy Community Centre/ Santoy Road Field/Green Space in Santoy (10.1%)
- Logwood Community Centre/Ball Field (3.0%)
- Industry Cove Green Space (4.0%)
- Cousins Cove Community Centre (10.1%)
- Cauldwell Community Centre (4.5%) (now occupied by the military since the State of Emergency [SOE])

- Pell River Community Centre/Ball Field (10.1%)
- Friendship Greenspace (3.0%)
- Grange Greenspace (9.1%)
- Spring Valley Greenspace (5.6%)
- Prospect Greenspace (0.5%)
- Salt Spring Greenspace (2.5%)
- Rhodes Hall Greenspace (0.5%)
- Orange Bay Playing Field (1.0%)
- Kingsvale Playing Field (3.0%)

On the issue of respondents' awareness of Princess Hotels and Resorts, all (100.0%) interviewees offered a response. Just over nineteen percent (19.3%) of interviewees stated that they had heard of the hotel, while 80.7% stated that they had not heard of Princess Hotels and Resorts.

Regarding respondents' awareness of proposed hotel construction, all (100%) respondents offered a response. Of these individuals, approximately thirty-eight percent (37.7%) of individuals stated that they had heard of the proposed project while 62.3% stated that they had never heard of the project. Of the 37.7% of respondents who heard of the project, 5.3% stated television, 2.7% indicated radio, 4.4% of interviewees stated they were made aware via community meeting and 84.1% indicated word of mouth while 0.1% stated "other" and further stated that they were made aware by direct observation. It should be noted that 2.7% of respondents while indicating awareness did not specify the medium by which they were made aware.

Regarding what was specifically known/heard the proposed project, 96.5% stated that they were aware that the hotel was to be built. Some respondents (3.5%) while indicating awareness did not offer specific information.

As it regarded respondents' awareness of the development of a wastewater treatment plant, all interviewees (100.0%) offered a response. Approximately three percent (3.3%) of interviewees stated that they were aware of the proposed wastewater treatment plant construction while 96.7% stated that they were not aware of this project component. Regarding what was specifically heard, fifty percent (50.0%) of those indicating awareness (3.3%) stated that they knew of the proposed construction. Some respondents (50.0%) while indicating awareness did not offer specific information.

Of the 3.3% of respondents who heard of the wastewater treatment plant project, 10.0% stated television, and 70.0% indicated word of mouth. It should be noted that 20.0% of respondents while indicating awareness did not specify the medium by which they were made aware.

As it regarded respondents' awareness of the proposed drainage system, all interviewees (100.0%) offered a response. Approximately four percent (3.7%) of interviewees stated that they were aware of the proposed drainage upgrade while 96.3% stated that they were not aware of this project component. Regarding what was specifically heard, approximately (18.2%) of those indicating awareness (3.7%)

stated that they knew of the proposed drainage system upgrade. Some respondents (81.8%) while indicating awareness did not offer specific information.

Of the 3.7% of respondents who heard of the drainage system upgrade, 18.2% stated television, and 63.6% indicated word of mouth. It should be noted that 18.2% of respondents while indicating awareness did not specify the medium by which they were made aware.

As it pertained to respondents' awareness of the whether there have been problems/issues in the Industry Bay area, all (100.0%) respondents offered a response. Of these individuals, 0.7% of individuals stated that there have been problems/issues in the Industry Bay area while 73.0% stated that there have never been any problems/issues in the area. Approximately twenty-six percent (26.3%) of respondents stated that they were not aware of any problems/issues in the area.

As it pertained to those interviewees indicating that there have been problems/issues in the Industry Bay area, the following problems/issues were highlighted:

- Past incidence of crime (50.0%)
- Unstable sections of the sea floor (Sink holes) (50.0%)

Regarding whether respondents had any concerns about the project, 100.0% of interviewees offered responses. Of these persons, 19.0% indicated that they had concerns about the project while 73.3% stated that they did not have any concern while 7.7% of respondents indicated that they were not sure if they had any concerns, as they needed more information. Concerns expressed pertained to:

- The project resulting in further road damage (5.3%)
- Increases solid waste (3.5%)
- Impact on fishing livelihood (5.2%)
- Wastewater disposal (14.0%)
- Impact on marine life (5.2%)
- Suitability of property size for size of project (1.8%)
- Job opportunity (especially for local community) (31.6%)
- Lack of information (1.8%)
- Impact/disruption of normal life activities (1.8%)
- Relocation (3.5%)
- Increased risk of flooding (5.2%)
- Whether the community will benefit from drainage upgrades and sewage infrastructure (5.3%)
- Pollution (noise/water/air) (3.5%)
- When the project would commence (5.2%)
- The project attracting criminal elements during construction phase (5.3%)
- The location of the wastewater treatment plant (1.8%)

On the issue of whether respondents depended on the proposed location for any business or activity, all (100.0%) interviewees offered a response. Approximately nine percent (9.3%) of respondents indicated that they used the proposed location for some type of business or activity while 90.7% stated that they did not use the area for any type of business or activity. Of those who confirmed that they depended on the proposed area (9.3%), individuals stated that they depended on the area for:

- Fishing (60.7%)
- Recreation (7.1%)
- To purchase fish (32.2%)

As it pertained to respondents' knowing anyone who depended on the proposed area for any type of business or activity, all persons (100.0%) offered a response. Twenty-four percent (24.0%) of respondents confirmed that they knew someone who depended on the proposed project area for some type of business of activity, while 76.0% of individuals indicated that they did not know of anyone who depended on the area. Of those who confirmed that they know of someone who depended on the proposed area (24.0%), it was stated that they depended on the area for:

- Fishing (to include vending) (97.2%)
- Residence/dwelling (1.4%)
- Recreation (4.2%)
- Crab hunting (1.4%)

It should be noted that percentages exceeded 100.0% as some respondents indicated dependence on the area for multiple activities.

Regarding respondents' opinions on how they anticipated the project to affect their lives, 99.7% of interviewees offered a response. Of these individuals, 32.0% of respondents indicated that the project would not affect their life in any way, while 50.2% anticipated a positive impact and 1.7% anticipated a negative impact. Just over sixteen percent (16.1%) were not sure if the project would affect their life.

Regarding the 50.0% of individuals anticipating a positive impact, they anticipated:

- Job opportunities would be created (86.0%)
- Economic Growth (8.7%)
- Community Development (9.3%)
- Increased patronage by tourists (0.7%)
- Improved infrastructure (0.7%)

Percentages exceeded 100.0% as respondents offered multiple responses.

As it pertained to the 1.7% of interviewees who indicated that they thought the project would affect their lives negatively, they anticipated:

- Decreased fish catch/yield (20.0%)
- Loss of Mangroves (20.0%)

- Loss of fishing activity (to include vending) (40.0%)
- Wildlife destruction (20.0%)
- Influx of criminal elements during construction phase (20.0%)
- Pollution (to include, noise air and water) (20.0%)

Percentages exceeded 100.0% as respondents offered multiple responses.

On the issue of how interviewees thought the project would affect the marine life, 99.7% of those interviewed offered a response. Of these, 31.4% indicated that they were unsure about how the marine life would be affected while 53.2% indicated that the marine life would not be affected. Less than one percent (0.3%) indicated that the marine life would be positively affected while 15.1% indicated that the project would negatively impact the marine life.

Of those expecting a positive impact on the marine life (0.3%), no one interviewed offered a specific response.

For those anticipating a negative impact on the marine life (15.1%), it was expressed that the construction of the overwater suites would result in:

- Coral reef destruction (2.2%)
- Fish migration (48.9%)
- Harmful “chemical” discharge into the ocean (to include leachate from marl) (13.3%)
- Loss of marine life (flora and fauna) (15.6%)
- Loss of Mangroves (6.7%)
- Sewage discharge into the ocean (8.9%)
- Improper solid waste disposal (specifically into the ocean) (6.7%)

Percentages exceeded 100.0% as respondents offered multiple responses.

On the issue of how interviewees thought the project would affect the general environment, 98.7% of those interviewed offered a response. Of these, 33.0% indicated that they were unsure about how the general environment would be affected while 54.4% indicated that the general environment would not be affected. Just under seven percent (6.8%) indicated that the general would be positively affected while 6.1% indicated that the project would negatively impact the general environment.

Of those expecting a positive impact on the general environment (6.8%), eighty percent (80.0%) stated that the anticipated community development as a positive impact. The remaining 20.0% offered no specific information.

For those anticipating a negative impact on the general environment (6.1%), it was expressed that the project would result in:

- Damage to the environment (16.7%)
- Improper sewage disposal (11.1%)

- Increased air pollution (44.4%)
- Damage to coral reef (5.6%)
- Deforestation (5.6%)
- Loss of marine life (flora and fauna) (5.6%)
- Introduction of disease into the area by foreigners (5.6%)

Some respondents (5.6%) offered no response.

Regarding how interviewees thought the project would impact flooding in nearby areas, 99.7% of those interviewed offered a response. Of these, 36.4% indicated that they were unsure about how flooding may be impacted while 60.2% indicated that the project would not impact flooding. Just under one percent (0.7%) indicated that there would be a positive impact while 2.7% indicated that the project would negatively impact flooding in nearby areas.

Of those expecting a positive impact on flooding in nearby areas (00.7%), all respondents (100.0%) stated that the project would reduce the risk of flooding in nearby areas.

For those anticipating a negative impact on flooding in nearby areas (2.7%), 87.5% of expressed that the new infrastructure would result in (cause) flooding. Some respondents (12.5%) offered no response.

As it related to housing 99.3% of interviewees offered responses. Approximately sixty-one percent (61.4%) of respondents stated that they owned the house they lived in, 0.7% stated that their residence was leased, 9.4% lived in rented homes, 1.0% indicated that they squatted in their homes, while 26.5% stated that they lived in family owned homes. No one interviewed lived in government owned housing, while 1.0% stated “other” and further advised that they were caretakers overseeing the homes they lived in.

As it pertained to the land on which dwelling homes were located 99.3% of interviewees offered responses. Approximately twenty percent (19.5%) of respondents stated that they owned the land on which the house is located, 18.5% stated that the land was leased, 3.7% had their homes on government owned lands, 9.1% indicated that they squatted on the land, while 39.9% stated that their homes were built on family land, while 9.3% stated “other” and indicated that the home they lived in was rented but there was no arrangement made with respect to the land while some persons indicated that they were caretakers.

Regarding the type of wall that dwellings were made of 52.3% of interviewees indicated that the walls of their homes were made of concrete and blocks while 61.0% stated wood/board and 0.3% stated zinc. It should be noted that percentages exceeded 100.0% as some respondents indicated that the walls of their homes were made of both concrete and blocks and wood/board materials. This was mainly due to structural additions to increase habitable living space.

Regarding the type of roof that dwellings had, 76.0% of respondents indicated that the roof of their homes was metal sheeting, while 29.0% stated concrete, 1.0% stated wood as the roof material while 0.3% stated “other” but did not specify the roof material. Percentages exceeded 100.0% as roofs were made of multiple materials, in most instances metal sheeting and concrete. This was due to structural additions to increase habitable living space.

As it pertained to the type of toilet facility present, 83.8% of respondents indicated that their homes had water closets, while 15.5% stated that pit latrine was the toilet facility and 0.7% indicated that their homes did not have a toilet facility.

As it related to what the household used for lighting, 97.7% of interviewees stated that electricity was used while 1.3% stated kerosene oil and 0.3% stated solar was used. Just under one percent (0.7%) stated “other” and further indicated that charge lights (50.0%) and mobile phone flashlights (50.0%) were used for household lighting.

Regarding the type of fuel used mostly for cooking, 95.3% of persons interviewed indicated that gas was used mostly, 2.7% stated electricity as the main cooking fuel, while 0.7% stated that they mostly used wood for cooking and 1.3% stated that coal was mostly used as the cooking fuel. While not represented quantitatively, during the survey exercise it was realised that some persons used both gas and coal; the coal was the secondary fuel when the gas was depleted prior to being replaced.

On the issue of the main source of household domestic water supply 79.3% of respondents confirmed that their household domestic water supply was the public piped water supply. Twelve percent (12.0%) stated the private tank as the main domestic water supply while 0.3% stated the community tank. Approximately three percent (2.7%) indicated that the public standpipe was the main source of domestic water supply for the household while 0.3% stated that household water was supplied by government water truck and 2.7% stated private water truck while 2.0% stated the spring/river as the main source of domestic water. Just under one percent of respondents (0.7%) stated “other” as the main source of household domestic water and further advised that they harvested rainwater.

As it pertained to respondents’ having any problems with the domestic water supply, 23.1% of those interviewed indicated that there were problems with the water supply while 76.9% indicated that there were no problems with the domestic water supply. For those persons who confirmed that there were problems with the domestic water supply 11.6% indicated that there was no water at all, 5.8% stated that no pipes were run in the area, 63.8% indicated that the water supply was irregular while 17.4% stated that water pressure was low and 2.5% of respondents stated “other” and indicated that they did not apply for a connection, experienced high turbidity following rainfall events and had issues of water pipes bursting frequently. Responses exceeded 100% as some individuals indicated that there were multiple problems being experienced with their water supply.

In response to how persons coped with problems related to domestic/household water supply, of those confirming that there were problems with supply (23.1%), approximately six percent (5.8%) of respondents indicated that they stored water, 29.0% indicated that they harvested/collected rain water, 39.1% stated that they bought water, 15.9% also stated that they collected water from a spring or river while 14.5% stated that they used the community standpipe and 4.3% stated that water was supplied by the water truck. The remaining 12.5% of persons did not offer any specific information. Responses exceeded 100% as some individuals indicated that there were multiple problems being experienced with their water supply.

On the issue of access to a residential (fixed line/landline) telephone 83.9% of interviewees indicated that they did not have access to a residential telephone while 16.1% confirmed that they had access. Of the 83.9% of persons indicating that they did not have a fixed line at their residence 96.8% of these individuals indicated that they owned a mobile phone. Additionally, 22.8% of these individuals indicated that they knew of someone who had a fixed-line service.

Regarding the main method of garbage disposal for households, 88.3% of those interviewed indicated that the public garbage truck was the main garbage disposal method while the remaining 11.7% indicated that burning was the main method used to dispose of garbage while. No one interviewed stated "private collection" as the main method of garbage disposal for households.

Regarding the frequency of collections of the 88.3% of respondents who indicated that the garbage truck was the main method of garbage disposal, 48.1% indicated that garbage collections were done once per week, 15.9% stated twice per week, 17.8% stated every two weeks, 15.9% stated once per month, 1.9% stated less than once per month. Less than one percent (0.4%) of respondents did not indicate the frequency for collections.

When asked about flooding all persons (100.0%) interviewed offered a response. Just over six percent (6.4%) of respondents indicated that their community was affected by flooding while 92.3% stated that flooding did not affect their community and 1.3% stated that they did not know if flooding affected their community. Those indicating that their community was affected stated that flooding occurred only during times of heavy rain (73.7%), each time there was a rainfall event (15.8%) and during hurricanes (5.3%) while 5.2% of interviewees did not state when flooding occurred. These respondents also indicated that rain events causing flooding occurred:

- Once weekly (10.5%)
- Once monthly (15.8%)
- Once every three months (42.1%)
- Once in six months (10.5%)
- Once per year (5.3%)
- Less than once per year (10.5%)

Some respondents (5.3%) did not indicate how often there was a rainfall event to cause flooding.

Affected areas named were:

- Salt Spring Bridge
- Coastline Area in Green Island
- Mangroves in the Industry Cove Area

- Green Island Main Road
- Haughton/Hopeful Area
- Cousins Cove Community
- Santoy Main Road
- Grange Square

Regarding the height to which water levels rose 89.5% of those confirming that flooding occurred offered a response. Of these respondents, 41.2% stated that water levels were less than 0.3 metre, 47.0% stated that during times of flooding water levels rose to between 0.3 and 1.5 metres while 11.8% advised that water levels exceeded 1.5 metres.

Regarding whether there were problems with frequent flooding at or near the proposed site, 64.0% of interviewees, stated that the area was not affected by flooding, while 34.0% stated that they did not know if the area was affected, while 2.0% stated that the area was affected by flooding. Of the 2.0% of those stating that there were flooding problems, 83.0% stated only in times of heavy rains while the remaining 16.7% stated during hurricanes. These respondents also indicated that rain events causing flooding occurred:

- Once monthly (33.3%)
- Once every three months (50.0%)
- Less than once per year (16.7%)

Specific areas named were:

- Green Island Main Road Main Road
- Harding Hall

On the issue of how high-water levels rose, 83.3% of those indicating that at or nearby the proposed area was affected by flooding offered a response. Of this number 40.0% indicated that water levels were less than 0.3 metres while 60.0% stated that water levels rose to between 0.3 and 1.5 metres.

On the issue of whether the proposed area was affected by tidal changes such as sea level rise or storm surge 99.7% of interviewees offered a response. Approximately Fifty-one percent (50.5%) of respondents stated that they did not know if the area was affected while 46.5% stated that the area was not affected by tidal changes and 3.0% indicated that the area was affected by tidal changes.

As it pertained to whether the proposed area was affected by beach erosion in the past 99.7% of interviewees offered a response. Approximately Fifty-nine percent (58.5%) of respondents stated that they did not know if the area was affected while 40.2% stated that the area was not affected by beach erosion in the past and 1.3% indicated that the area was affected.

Regarding whether there was any site nearby considered to be a protected area, historic area or area of national, historic or environmental importance, 43.8% of interviewees stated they did not know of any such area or site, 52.2% stated that no such area was located near to the proposed area while 4.0% indicated that there was an area/site which was considered to be a protected area or area of historic, national or environmental importance.

Places named were:

- The fish nursery in Green Island
- The Oyster nursery in Green Island
- Green Island Harbour
- The Town of Green Island
- The Turtle Sanctuary in the Industry Cove/Cousins Cove Area

7.1.2.2 Green Island

Approximately twenty percent (19.7%) of respondents were from the Green Island community. Approximately fifty-nine percent (59.3%) of respondents were male and 40.7% were female.

Age cohort distribution was as follows; 10.2% were 18-25 years of age, 22.0% were 26-33 years, 23.7% were age 34-41 years, 27.1% were age 42-50 years, 10.2% were age 51-60 years and 6.8% were older than sixty years of age.

Of those persons interviewed who offered a response (100.0%), 49.2% indicated that they were self-employed, while 42.3% stated that they had an employer and 6.8% stated they were unemployed. Approximately two percent (1.7%) of individuals were retired. Additionally, 72.9% of interviewees when asked confirmed that they were the head of their household while 27.1% indicated that they were not the household head.

Regarding the number of persons residing in households, approximately twelve percent (11.9%) of households had one occupant while 22.0% had two occupants, 16.9% had three occupants and similarly 16.9% had four persons living in the household. Approximately seventeen percent (16.9%) had five persons living in the household and 15.4% of households had more than five persons residing.

In general, interviewees resided in their communities over the long term. Approximately forty-nine percent (49.1%) of individuals resided in their communities for all their life, and 22.2% resided in their community in excess of fifteen years. Approximately nine percent (8.5%) stated they lived in their community for between ten and fifteen years while 8.5% resided for between five and ten years. Approximately nine percent (8.5%) also resided in their community for between three and five years and 3.4% for under two years.

On the issue of where healthcare was mostly obtained, 11.9% stated the public clinic, 52.5% stated the public hospital and 40.7% stated that healthcare needs were mostly sourced through the private doctor. It should be noted that in some instances, respondents offered multiple responses regarding where they mainly went for healthcare, therefore percentages exceeded one hundred.

As it related to whether respondents suffered from specific medical conditions, 11.9% of interviewees indicated that they were asthmatic, 13.6% indicated that they suffered from sinusitis, no one (0.0%) confirmed coughing as an ailment, nor indicated that they suffered from congestion/bronchial problems. Just over three percent (3.4%) indicated that they suffered from chest pains while none (0.0%) of those interviewed confirmed frequent bouts of diarrhoea. Approximately seventy-three (72.9%) percent of those interviewed indicated that they did not suffer from any of the specific conditions named. It should be noted that in some instances, respondents suffered from more than one of the listed ailments, therefore percentages exceeded one hundred.

Of those interviewed, just under twenty-nine percent (28.8%) of respondents refused to offer a response relating to their personal weekly income. Approximately nine percent (8.5%) of persons indicated that they did not have a weekly income, while no one (0.0%) indicated that their weekly income was under the previous national minimum wage of $6,200.00 per week. Approximately two percent (1.7%) of interviewees indicated that their weekly income was $6,200.00 per week; 16.9% stated that their weekly income was between $6,201.00-$10,000.00, while 35.6% stated a weekly income ranging between $10,001.00 and $20,000.00. Approximately nine percent (8.5%) indicated that their weekly income was in excess of twenty thousand dollars ($20,000.00).

Regarding the highest level of education completed, all persons interviewed (100.0%) offered a response. Of this number just under two percent (1.7%) indicated that they did not attend school; 11.9% stated they completed primary/all age school, 3.3% stated that they did not complete high school, 62.7% completed high school, 3.4% college, 3.4% university and 13.6% HEART/Vocational Training Institution.

As it pertained to education, 64.4% of interviewees indicated someone in the household was attending school. As it related to the school being attended 28.9% stated that the school being attended was infant/basic, 52.6% stated primary/all age, 55.3% stated high school, 0.0% college 2.6% university and no one indicated (0.0%) HEART/Vocational Training Institute. It should be noted that percentages will exceed one hundred as multiple persons from households attend school.

When respondents were asked about the presence of recreational spaces in their community 73.2% of those offering a response indicated that a recreational space was present. Recreational spaces named were:

- Haughton Community Centre (22.0%)
- Green Island High School Field (51.2%)
- Green Island Community Centre (24.4%)
- Santoy Community Centre/ Santoy Road Field/Green Space in Santoy (2.4%)

On the issue of respondents' awareness of Princess Hotels and Resorts, all (100.0%) interviewees offered a response. Just over fifteen percent (15.3%) of interviewees stated that they had heard of the hotel, while 84.7% stated that they had not heard of Princess Hotels and Resorts.

Regarding respondents' awareness of proposed hotel construction, all (100%) of respondents offered a response. Of these individuals, approximately forty-eight percent (47.5%) of individuals stated that they had heard of the proposed project while 52.5% stated that they had never heard of the project. Of the 47.5% of respondents who heard of the project, 7.1% stated television, 3.6% indicated radio, 7.1% of interviewees stated they were made aware via community meeting and 71.4% indicated word of mouth as the medium by which they were made aware. It should be noted that 10.8% of respondents while indicating awareness did not specify the medium by which they were made aware.

Regarding what was specifically known/heard about the proposed project, everyone interviewed (100.0%) stated that they were aware that the hotel was to be built.

As it regarded respondents' awareness of the development of a wastewater treatment plant, all interviewees (100.0%) offered a response and further stated that they were not aware of this project component.

As it regarded respondents' awareness of the proposed drainage system, all interviewees (100.0%) offered a response. Approximately two percent (1.7%) of interviewees stated that they were aware of the proposed drainage upgrade while 98.3% stated that they were not aware of this project component. Regarding what was specifically heard, the 1.7% of respondents while indicating awareness did not offer specific information. They however stated that awareness was via the television medium.

As it pertained to respondents' awareness of the whether there have been problems/issues in the Industry Bay area, all (100.0%) of respondents offered a response. Of these individuals, 3.4% of individuals stated that there have been problems/issues in the Industry Bay area while 84.7% stated that there have never been any problems/issues in the area. Approximately twelve percent (11.9%) of respondents stated that they were not aware of any problems/issues in the area.

As it pertained to those interviewees indicating that there have been problems/issues in the Industry Bay area, the following problems/issues were highlighted:

- Past incidence of crime (50.0%)
- Unstable sections of the sea floor (Sink holes) (50.0%)

Regarding whether respondents had any concerns about the project, 100.0% of interviewees offered responses. Of these persons, 37.3% indicated that they had concerns about the project while 54.2% stated that they did not have any concern while 8.5% of respondents indicated that they were not sure if they had any concerns, as they needed more information. Concerns expressed pertained to:

- The project resulting in further road damage (4.5%)
- Increases solid waste (4.5%)
- Impact on fishing livelihood (13.6%)

- Wastewater disposal (9.1%)
- Impact on marine life (4.5%)
- Suitability of property size for size of project (4.5%)
- Job opportunity (especially for local community) (27.3%)
- Lack of information (4.6%)
- Impact/disruption of normal life activities (4.5%)
- Relocation (4.6%)
- Increased risk of flooding (4.6%)
- Whether the community will benefit from drainage upgrades and sewage infrastructure (4.6%)
- Pollution (noise/water/air) (4.6%)
- When the project would commence (4.5%)

On the issue of whether respondents depended on the proposed location for any business or activity, all (100.0%) interviewees offered a response. Approximately nineteen percent (18.6%) of respondents indicated that they used the proposed location for some type of business or activity while 81.4% stated that they did not use the area for any type of business or activity. Of those who confirmed that they depended on the proposed area (18.6%), individuals stated that they depended on the area for:

- Fishing (81.1%)
- Recreation (9.1%)

Some respondents (10.1%) while indicating dependence on the area did not offer specific information

As it pertained to respondents' knowing anyone who depended on the proposed area for any type of business or activity, all persons (100.0%) offered a response. Approximately thirty-four percent (33.9%) of respondents confirmed that they knew someone who depended on the proposed project area for some type of business of activity, while 66.1% of individuals indicated that they did not know of anyone who depended on the area. Of those who confirmed that they know of someone who depended on the proposed area (33.9%), it was stated that they depended on the area for:

- Fishing (to include vending) (100.0%)
- Residence/dwelling (5.0%)

- Recreation (5.0%)

It should be noted that percentages exceeded 100.0% as some respondents indicated dependence on the area for multiple activities.

Regarding respondents' opinions on how they anticipated the project to affect their lives, 100.0% of interviewees offered a response. Of these individuals, 18.6% of respondents indicated that the project would not affect their life in any way, while 54.2% anticipated a positive impact and 5.2% anticipated a negative impact. Twenty-two percent (22.0%) were not sure if the project would affect their life.

Regarding the 54.2% of individuals anticipating a positive impact, they anticipated:

- Job opportunities would be created (78.1%)
- Economic Growth (21.9%)
- Community Development (3.1%)

Percentages exceeded 100.0% as respondents offered multiple responses.

As it pertained to the 5.2% of interviewees who indicated that they thought the project would affect their lives negatively, they anticipated:

- Decreased fish catch/yield (33.3%)
- Loss of Mangroves (33.3%)
- Loss of fishing activity (to include vending) (66.7%)
- Wildlife destruction (33.3%)

Percentages exceeded 100.0% as respondents offered multiple responses.

On the issue of how interviewees thought the project would affect the marine life, 100.0% of those interviewed offered a response. Of these, 33.9% indicated that they were unsure about how the marine life would be affected while 45.8% indicated that the marine life would not be affected. No one interviewed (0.0%) indicated that the marine life would be positively affected while 20.3% indicated that the project would negatively impact the marine life.

For those anticipating a negative impact on the marine life (20.3%), it was expressed that the construction project would result in:

- Coral reef destruction (8.3%)
- Fish migration (25.0%)

- Harmful “chemical” discharge into the ocean (to include leachate from marl) (33.3%)
- Loss of marine life (flora and fauna) (25.0%)
- Loss of Mangroves (25.0%)

Percentages exceeded 100.0% as respondents offered multiple responses.

On the issue of how interviewees thought the project would affect the general environment, 100.0% of those interviewed offered a response. Of these, 28.8% indicated that they were unsure about how the general environment would be affected while 59.3% indicated that the general environment would not be affected. Just over three percent (3.4%) indicated that the general environment would be positively affected while 8.5% indicated that the project would negatively impact the general environment.

Of those expecting a positive impact on the general environment (3.4%), all individuals (100.0%) stated that they anticipated community development as a positive impact.

For those anticipating a negative impact on the general environment (8.5%), it was expressed that the project would result in:

- Damage to the environment (20.0%)
- Improper sewage disposal (40.0%)
- Increased air pollution (40.0%)

Regarding how interviewees thought the project would impact flooding in nearby areas, 100.0% of those interviewed offered a response. Of these, 35.6% indicated that they were unsure about how flooding may be impacted while 57.6% indicated that the project would not impact flooding. Just under two percent 10.7%) indicated that there would be a positive impact while 5.1% indicated that the project would negatively impact flooding in nearby areas.

Of those expecting a positive impact on flooding in nearby areas (1.7%), all respondents (100.0%) stated that the project would reduce the risk of flooding in nearby areas.

For those anticipating a negative impact on flooding in nearby areas (5.1%), all individuals (100.0%) expressed that the new infrastructure would result in (cause) flooding.

As it related to housing 98.3% of interviewees offered responses. Approximately sixty-seven percent (67.2%) of respondents stated that they owned the house they lived in, no one (0.0%) stated that their residence was leased, nor did they indicate squatting, 8.6% lived in rented homes, while 24.2% stated that they lived in family owned homes.

As it pertained to the land on which dwelling homes were located 98.3% of interviewees offered responses. Nineteen percent (19.0%) of respondents stated that they owned the land on which the house is located, 17.2% stated that the land was leased, 8.6% had their homes on government owned lands, 12.1% indicated that they squatted on the land, while 36.2% stated that their homes were built on family land, while 6.9% stated “other” and indicated that the home they lived in was rented but there was no arrangement made with respect to the land.

Regarding the type of wall that dwellings were made of 54.2% of interviewees indicated that the walls of their homes were made of concrete and blocks while 61.0% stated wood/board. It should be noted that percentages exceeded 100.0% as some respondents indicated that the walls of their homes were made of both concrete and blocks and wood/board materials. This was mainly due to structural additions to increase habitable living space.

Regarding the type of roof that dwellings had, 78.0% of respondents indicated that the roof of their homes was metal sheeting, while 27.1% stated concrete. Percentages exceeded 100.0% as roofs were made of multiple materials, in most instances metal sheeting and concrete. This was due to structural additions to increase habitable living space.

As it pertained to the type of toilet facility present, 93.1% of respondents indicated that their homes had water closets, while 6.9% stated that pit latrine was the toilet facility.

As it related to what the household used for lighting, 96.6% of interviewees stated that electricity was used and 1.7% stated solar was used. Just under two percent (1.7%) stated “other” and further indicated that charge lights (100.0%) were used for household lighting.

Regarding the type of fuel used mostly for cooking, all (100.0%) of persons interviewed indicated that gas was used mostly.

On the issue of the main source of household domestic water supply 96.6% of respondents confirmed that their household domestic water supply was the public piped water supply. Approximately two percent (2.0%) stated the private tank as the main domestic water supply. Just under two percent of respondents (1.7%) stated “other” as the main source of household domestic water and further advised that they harvested rainwater.

As it pertained to respondents’ having any problems with the domestic water supply, 20.3% of those interviewed indicated that there were problems with the water supply while 79.7% indicated that there were no problems with the domestic water supply. For those persons who confirmed that there were problems with the domestic water supply, 8.3% stated that no pipes were run in the area, 50.0% indicated that the water supply was irregular while 33.4% stated that water pressure was low and 8.3% of respondents stated “other” and indicated that they had issues of water pipes bursting frequently.

In response to how persons coped with problems related to domestic/household water supply, of those confirming that there were problems with supply (20.3%), approximately eight percent (8.3%) of respondents indicated that they stored water, 41.7% indicated that they harvested/collected rain water, 25.0% stated that they bought water, 8.3% also stated that they collected water from a spring or river The remaining 16.7% of persons did not offer any specific information.

On the issue of access to a residential (fixed line/landline) telephone 89.8% of interviewees indicated that they did not have access to a residential telephone while 10.0% confirmed that they had access. Of the 89.8% of persons indicating that they did not have a fixed line at their residence 98.1% of these individuals indicated that they owned a mobile phone. Additionally, 15.1% of these individuals indicated that they knew of someone who had a fixed-line service.

Regarding the main method of garbage disposal for households, 98.3% of those interviewed indicated that the public garbage truck was the main garbage disposal method while the remaining 1.7% indicated that burning was the main method used to dispose of garbage.

Regarding the frequency of collections of the 98.3% of respondents who indicated that the garbage truck was the main method of garbage disposal, 58.6% indicated that garbage collections were done once per week, 24.2% stated twice per week, 8.6% stated every two weeks and 8.6% also stated once per month.

When asked about flooding all persons (100.0%) interviewed offered a response. Approximately nine percent (8.5%) of respondents indicated that their community was affected by flooding while 91.5% stated that flooding did not affect their community. Those indicating that their community was affected stated that flooding occurred only during times of heavy rain (60.0%), each time there was a rainfall event (20.0%) and during hurricanes (20.0%). These respondents also indicated that rain events causing flooding occurred:

- Once every three months (60.0%)
- Once per year (20.0%)
- Less than once per year (20.0%)

Affected areas named were:

- Salt Spring Bridge
- Coastline Area in Green Island
- Green Island Main Road
- Haughton/Hopeful Area

Regarding the height to which water levels rose 100.0% of those confirming that flooding occurred offered a response. Of these respondents, 20.0% stated that water levels were less than 0.3 metre while 80.0% stated that during times of flooding water levels rose to between 0.3 and 1.5 metres while no one (0.0%) advised that water levels exceeded 1.5 metres.

Regarding whether there were problems with frequent flooding at or near the proposed site, 62.7% of interviewees, stated that the area was not affected by flooding, while 339% stated that they did not know if the area was affected, while 3.4% stated that the area was affected by flooding. Of the 3.4% of those stating that there were flooding problems, 100.0% stated only in times of heavy rains. These respondents also indicated that rain events causing flooding occurred:

- Once monthly (50.0%)
- Once every three months (50.0%)

Specific areas named were:

- Green Island Main Road Main Road

Regarding the height to which water levels rose, 100.0% of those indicating that at or nearby the proposed area was affected by flooding offered a response and further indicated that water levels were less than 0.3 metres.

On the issue of whether the proposed area was affected by tidal changes such as sea level rise or storm surge 100.0% of interviewees offered a response. Thirty-nine percent (39.0%) of respondents stated that they did not know if the area was affected while 55.9% stated that the area was not affected by tidal changes and 5.1% indicated that the area was affected by tidal changes.

As it pertained to whether the proposed area was affected by beach erosion in the past 100.0% of interviewees offered a response. Approximately forty-seven percent (47.4%) of respondents stated that they did not know if the area was affected while 49.2% stated that the area was not affected by beach erosion in the past and 3.4% indicated that the area was affected.

Regarding whether there was any site nearby considered to be a protected area, historic area or area of national, historic or environmental importance, 42.4% of interviewees stated they did not know of any such area or site, 42.4% stated that no such area was located near to the proposed area while 15.2% indicated that there was an area/site which was considered to be a protected area or area of historic, national or environmental importance.

Places named were:

- The fish nursery in Green Island
- The Oyster nursery in Green Island
- Green Island Harbour
- The Town of Green Island

7.1.2.3 Industry Cove

Twelve percent (12.0%) of respondents were from the Industry Cove community. Fifty percent (50.0%) of respondents were male and 50.0% were female.

Age cohort distribution was as follows; 5.5% were 18-25 years of age, 16.7% were 26-33 years, 22.2% were age 34-41 years, 22.2% were age 42-50 years, 16.7% were age 51-60 years and 16.7% were older than sixty years of age.

Of those persons interviewed who offered a response (100.0%), 55.6% indicated that they were self-employed, while 27.8% stated that they had an employer and 11.1% stated they were unemployed. Approximately six percent (5.5%) of individuals were retired. Additionally, 80.6% of interviewees when asked confirmed that they were the head of their household while 19.4% indicated that they were not the household head.

Regarding the number of persons residing in households, just over nineteen percent (19.4%) of households had one occupant while 16.7% had two occupants, 16.7% had three occupants while 19.4% had four persons living in the household. Approximately fourteen percent (13.9%) had five persons living in the household and 13.9% of households had more than five persons residing.

In general, interviewees resided in their communities over the long term. Just over sixty one percent (61.1%) of individuals resided in their communities for all their life, and 8.3% resided in their community in excess of fifteen years. Approximately fourteen percent (13.9%) stated they lived in their community for between ten and fifteen years; 11.1% resided for between five and ten years. Just under three percent (2.8%) resided in their community for between three and five years and 2.8% for under two years.

On the issue of where healthcare was mostly obtained, 19.4% stated the public clinic, 61.1% stated the public hospital and 33.3% stated that healthcare needs were mostly sourced through the private doctor. No one interviewed (0.0%) stated the private hospital. It should be noted that in some instances, respondents offered multiple responses regarding where they mainly went for healthcare, therefore percentages exceeded one hundred.

As it related to whether respondents suffered from specific medical conditions, 8.3% of interviewees indicated that they were asthmatic, 13.9% indicated that they suffered from sinusitis, 2.8% confirmed coughing as an ailment, while no one (0.0%) indicated that they suffered from congestion/bronchial problems. Just over eight percent (8.3%) indicated that they suffered from chest pains while 2.8% of those interviewed confirmed frequent bouts of diarrhoea. Approximately seventy-two (72.2%) percent of those interviewed indicated that they did not suffer from any of the specific conditions named. It should be noted that in some instances, respondents suffered from more than one of the listed ailments, therefore percentages exceeded one hundred.

Of those interviewed, 25.0% of respondents refused to offer a response relating to their personal weekly income. Just over eleven percent (11.1%) of persons indicated that they did not have a weekly income, while 5.6% indicated that their weekly income was under the previous national minimum wage of

$6,200.00 per week. No one interviewed (0.0%) indicated that their weekly income was $6,200.00 per week; 19.4% stated that their weekly income was between $6,201.00-$10,000.00, while 27.8% stated a weekly income ranging between $10,001.00 and $20,000.00. Just over eleven percent (11.1%) indicated that their weekly income was in excess of twenty thousand dollars ($20,000.00).

Regarding the highest level of education completed, all persons interviewed (100.0%) offered a response. Of this number no one interviewed (0.0%) indicated that they did not attend school; 16.7% stated they completed primary/all age school, 5.6% stated that they did not complete high school, 58.3% completed high school, 5.6% college, 0.0% university and 13.9% HEART/Vocational Training Institution.

As it pertained to education, 58.3% of interviewees indicated someone in the household was attending school. As it related to the school being attended 38.1% stated that the school being attended was infant/basic, 61.9% stated primary/all age, 42.9% stated high school, 4.8% college 4.8% university and 4.8% HEART/Vocational Training Institute. It should be noted that percentages will exceed one hundred as multiple persons from households attend school.

When respondents were asked about the presence of recreational spaces in their community 75.0% of those offering a response indicated that a recreational space was present. In many instances, there was no established recreational space, the community instead has cleaned a maintained greenspace especially for the playing of community football (soccer). Recreational spaces named were:

- Green Island High School Field (70.4%)
- Industry Cove Green Space (29.6%)

On the issue of respondents' awareness of Princess Hotels and Resorts, all (100.0%) interviewees offered a response. Just under forty-two percent (41.7%) of interviewees stated that they had heard of the hotel, while 58.3% stated that they had not heard of Princess Hotels and Resorts.

Regarding respondents' awareness of proposed hotel construction, all (100%) respondents offered a response. Of these individuals, approximately sixty-nine percent (69.4%) of individuals stated that they had heard of the proposed project while 30.6% stated that they had never heard of the project. Of the 30.6% of respondents who heard of the project, 8.0% stated television, 4.0% of interviewees stated they were made aware via community meeting and 88.0% indicated word of mouth as the medium by which they were made aware.

Regarding what was specifically known/heard about the proposed project, all persons indicating awareness (100.0%) stated that they were aware that the hotel was to be built.

As it regarded respondents' awareness of the development of a wastewater treatment plant, all interviewees (100.0%) offered a response. Approximately eight percent (8.3%) of interviewees stated that they were aware of the proposed wastewater treatment plant construction while 91.7% stated that they were not aware of this project component. Regarding what was specifically heard, all (100.0%) of those indicating awareness 8.3%) stated that they knew of the proposed construction.

Of the 8.3% of respondents who heard of the wastewater treatment plant project, 33.3% stated television, and 66.7% indicated word of mouth as the medium by which they were made aware.

As it regarded respondents' awareness of the proposed drainage system, all interviewees (100.0%) offered a response. Approximately six percent (5.6%) of interviewees stated that they were aware of the proposed drainage upgrade while 94.4% stated that they were not aware of this project component. Regarding what was specifically heard, 50.0% of those indicating awareness (5.6%) stated that they knew of the proposed drainage system upgrade. Some respondents (50.0%) while indicating awareness did not offer specific information.

Of the 5.6% of respondents who heard of the drainage system upgrade, 50.0% stated television, and 50.0% indicated word of mouth as the medium by which they were made aware.

As it pertained to respondents' awareness of the whether there have been problems/issues in the Industry Bay area, all (100.0%) respondents offered a response. Of these individuals, no one (0.0%) interviewed indicated that there have been problems/issues in the Industry Bay area while 88.9% stated that there have never been any problems/issues in the area. Approximately eleven percent (11.1%) of respondents stated that they were not aware of any problems/issues in the area.

Regarding whether respondents had any concerns about the project, 100.0% of interviewees offered responses. Of these persons, 5.6% indicated that they had concerns about the project while 88.8% stated that they did not have any concern while 5.6% of respondents indicated that they were not sure if they had any concerns, as they needed more information. Concerns expressed pertained to:

- Impact on marine life (50.0%)
- Whether the community will benefit from drainage upgrades and sewage infrastructure (50.0%)

On the issue of whether respondents depended on the proposed location for any business or activity, all (100.0%) interviewees offered a response. Approximately eleven percent (11.1%) of respondents indicated that they used the proposed location for some type of business or activity while 88.9% stated that they did not use the area for any type of business or activity. Of those who confirmed that they depended on the proposed area (11.1%), individuals stated that they depended on the area for:

- Fishing (100.0%)

As it pertained to respondents' knowing anyone who depended on the proposed area for any type of business or activity, all persons (100.0%) offered a response. Approximately twenty-eight percent (27.8%) of respondents confirmed that they knew someone who depended on the proposed project area for some type of business of activity, while 72.2% of individuals indicated that they did not know of anyone who depended on the area. Of those who confirmed that they know of someone who depended on the proposed area (27.8%), it was stated that they depended on the area for:

- Fishing (to include vending) (90.0%)

- Crab hunting (10.0%)

Regarding respondents' opinions on how they anticipated the project to affect their lives, 100.0% of interviewees offered a response. Of these individuals, 38.9% of respondents indicated that the project would not affect their life in any way, while 47.2% anticipated a positive impact and no one (0.0%) anticipated a negative impact. Just under fourteen percent (13.9%) were not sure if the project would affect their life.

Regarding the 47.2% of individuals anticipating a positive impact, they anticipated:

- Job opportunities would be created (64.7%)
- Economic Growth (23.5%)
- Community Development (23.5%)

Percentages exceeded 100.0% as respondents offered multiple responses.

On the issue of how interviewees thought the project would affect the marine life, 100.0% of those interviewed offered a response. Of these, 22.2% indicated that they were unsure about how the marine life would be affected while 72.2% indicated that the marine life would not be affected. No one interviewed (003%) indicated that the marine life would be positively affected while 5.6% indicated that the project would negatively impact the marine life.

For those anticipating a negative impact on the marine life (5.6%), it was expressed that the construction project would result in:

- Harmful "chemical" discharge into the ocean (to include leachate from marl) (100.0%)

On the issue of how interviewees thought the project would affect the general environment, 100.0% of those interviewed offered a response. Of these, 22.2% indicated that they were unsure about how the general environment would be affected while 69.4% indicated that the general environment would not be affected. Just under six percent (5.6%) indicated that the general environment would be positively affected while 2.8% indicated that the project would negatively impact the general environment.

Of those expecting a positive impact on the general environment (5.6%), none of the respondents offered a specific response.

For those anticipating a negative impact on the general environment (2.8%), it was expressed that the project would result in:

- Increased air pollution (100.0%)

Regarding how interviewees thought the project would impact flooding in nearby areas, 100.0% of those interviewed offered a response. Of these, 22.2% indicated that they were unsure about how flooding may be impacted while 75.0% indicated that the project would not impact flooding. No one interviewed (0.0%) indicated that there would be a positive impact while 2.8% indicated that the project would negatively impact flooding in nearby areas.

For those anticipating a negative impact on flooding in nearby areas (2.8%), 100.0% expressed that the new infrastructure would result in (cause) flooding.

As it related to housing 100.0% of interviewees offered responses. Approximately seventy-eight percent (77.8%) of respondents stated that they owned the house they lived in, 5.6% lived in rented homes, 2.8% indicated that they squatted in their homes, while 11.0% stated that they lived in family owned homes. No one interviewed lived in government owned housing, while 2.8% stated "other" and further advised that they were caretakers overseeing the homes they lived in.

As it pertained to the land on which dwelling homes were located 100.0% of interviewees offered responses. Just over nineteen percent (19.4%) of respondents stated that they owned the land on which the house is located, 22.2% stated that the land was leased, 0.0% had their homes on government owned lands, 13.9% indicated that they squatted on the land, while 36.2% stated that their homes were built on family land, while 8.3% stated "other" and indicated that the home they lived in was rented but there was no arrangement made with respect to the land while some persons indicated that they were caretakers.

Regarding the type of wall that dwellings were made of 61.1% of interviewees indicated that the walls of their homes were made of concrete and blocks while 58.3% stated wood/board. It should be noted that percentages exceeded 100.0% as some respondents indicated that the walls of their homes were made of both concrete and blocks and wood/board materials. This was mainly due to structural additions to increase habitable living space.

Regarding the type of roof that dwellings had, 83.3% of respondents indicated that the roof of their homes was metal sheeting, while 19.4% stated concrete, 2.8% stated wood as the roof. Percentages exceeded 100.0% as roofs were made of multiple materials, in most instances metal sheeting and concrete. This was due to structural additions to increase habitable living space.

As it pertained to the type of toilet facility present, 83.3% of respondents indicated that their homes had water closets, while 13.9% stated that pit latrine was the toilet facility and 2.8% indicated that their homes did not have a toilet facility.

As it related to what the household used for lighting, 94.4% of interviewees stated that electricity was used while 2.8% stated kerosene oil. Just under three percent (2.8%) stated "other" and further indicated that mobile phone flashlights (100.0%) were used for household lighting.

Regarding the type of fuel used mostly for cooking, 91.7% of persons interviewed indicated that gas was used mostly, 0.0% stated electricity as the main cooking fuel, while 2.8% stated that they mostly used wood for cooking and 5.5% stated that coal was mostly used as the cooking fuel.

On the issue of the main source of household domestic water supply 83.3% of respondents confirmed that their household domestic water supply was the public piped water supply. Approximately eleven percent (11.1%) stated the private tank as the main domestic water supply while 2.8% stated the community tank. Approximately three percent (2.8%) indicated that the public standpipe was the main source of domestic water supply for the household.

As it pertained to respondents' having any problems with the domestic water supply, 11.1% of those interviewed indicated that there were problems with the water supply while 88.9% indicated that there were no problems with the domestic water supply. For those persons who confirmed that there were problems with the domestic water supply, 50.0% indicated that there was no water at all, 25.0% stated that no pipes were run in the area, 25.0% also indicated that the water supply was irregular.

In response to how persons coped with problems related to domestic/household water supply, of those confirming that there were problems with supply (11.1%), 50.0% indicated that they harvested/collected rain water, 25.0% stated that they bought water, while 25.0% stated that they used the community standpipe.

On the issue of access to a residential (fixed line/landline) telephone 86.1% of interviewees indicated that they did not have access to a residential telephone while 13.9% confirmed that they had access. Of the 86.1% of persons indicating that they did not have a fixed line at their residence 93.5% of these individuals indicated that they owned a mobile phone. Additionally, 19.4% of these individuals indicated that they knew of someone who had a fixed-line service.

Regarding the main method of garbage disposal for households, 100.0% of those interviewed indicated that the public garbage truck was the main garbage disposal method.

Regarding the frequency of collections all respondents offered a response, of these, 58.3% indicated that garbage collections were done once per week, 33.4% stated twice per week and 8.3% stated every two weeks.

When asked about flooding all persons (100.0%) interviewed offered a response. Just over eight percent (8.3%) of respondents indicated that their community was affected by flooding while 86.1% stated that flooding did not affect their community and 5.6% stated that they did not know if flooding affected their community. Those indicating that their community was affected stated that flooding occurred only during times of heavy rain (66.7%) and each time there was a rainfall event (33.3%). These respondents also indicated that rain events causing flooding occurred:

- Once weekly (33.3%)
- Once in six months (66.7%)

Affected areas named were:

- Mangroves in the Industry Cove Area

Regarding the height to which water levels rose 100.0% of those confirming that flooding occurred offered a response and further indicated that water levels were less than 0.3 metre.

Regarding whether there were problems with frequent flooding at or near the proposed site, 77.8% of interviewees, stated that the area was not affected by flooding, while 22.2% stated that they did not know if the area was affected, while no one (0.0%) stated that the area was affected by flooding.

On the issue of whether the proposed area was affected by tidal changes such as sea level rise or storm surge 100.0% of interviewees offered a response. Approximately thirty-one percent (30.6%) of respondents stated that they did not know if the area was affected while 66.6% stated that the area was not affected by tidal changes and 2.8% indicated that the area was affected by tidal changes.

As it pertained to whether the proposed area was affected by beach erosion in the past 100.0% of interviewees offered a response. Twenty-five percent (25.0%) of respondents stated that they did not know if the area was affected while 75.0% stated that the area was not affected by beach erosion in the past and 0.0% indicated that the area was affected.

Regarding whether there was any site nearby considered to be a protected area, historic area or area of national, historic or environmental importance, 33.3% of interviewees stated they did not know of any such area or site, 63.9% stated that no such area was located near to the proposed area while 2.8% indicated that there was an area/site which was considered to be a protected area or area of historic, national or environmental importance.

Places named were:

- The Turtle Sanctuary in the Industry Cove/Cousins Cove Area

7.1.2.4 Cousins Cove

Approximately ten percent (10.3%) of respondents were from the Cousins Cove community. Approximately fifty-five percent (54.8%) of respondents were male and 45.2% were female.

Age cohort distribution was as follows; 22.6% were 18-25 years of age, 16.1% were 26-33 years, 19.4% were age 34-41 years, 16.1% were age 42-50 years, 12.9% were age 51-60 years and 12.9% were older than sixty years of age.

Of those persons interviewed who offered a response (100.0%), 32.2% indicated that they were self-employed, while 35.5% stated that they had an employer and 22.6% stated they were unemployed. Approximately ten percent (9.7%) of individuals were retired. Additionally, 58.1% of interviewees when asked confirmed that they were the head of their household while 41.9% indicated that they were not the household head.

Regarding the number of persons residing in households, approximately seven percent (6.5%) of households had one occupant while 19.4% had two occupants, 19.4% had three occupants while 25.8% had four persons living in the household. Sixteen percent (16.0%) had five persons living in the household and 12.9% of households had more than five persons residing.

In general, interviewees resided in their communities over the long term. Approximately sixty-five percent (64.5%) of individuals resided in their communities for all their life, and 25.8% resided in their community in excess of fifteen years. No one interviewed (0.0%) stated they lived in their community for between ten and fifteen years; 6.5% resided for between five and ten years. Just over three percent (3.2%) resided in their community for between three and five years and 0.0% for under two years.

On the issue of where healthcare was mostly obtained, 0.0% stated the public clinic, 54.8% stated the public hospital and 64.5% stated that healthcare needs were mostly sourced through the private doctor. No one interviewed (0.0%) stated the private hospital. It should be noted that in some instances, respondents offered multiple responses regarding where they mainly went for healthcare, therefore percentages exceeded one hundred.

As it related to whether respondents suffered from specific medical conditions, 12.9% of interviewees indicated that they were asthmatic, 25.8% indicated that they suffered from sinusitis and 3.2% confirmed coughing as an ailment. Approximately fifty-eight (58.1%) percent of those interviewed indicated that they did not suffer from any of the specific conditions named.

Of those interviewed, just under twenty-three percent (22.6%) of respondents refused to offer a response relating to their personal weekly income. Approximately sixteen percent (16.1%) of persons indicated that they did not have a weekly income, while 3.2% indicated that their weekly income was under the previous national minimum wage of $6,200.00 per week. No one interviewed (0.0%) indicated that their weekly income was $6,200.00 per week; 16.1% stated that their weekly income was between $6,201.00-$10,000.00, while 32.3% stated a weekly income ranging between $10,001.00 and $20,000.00. Just under nine percent (9.7%) indicated that their weekly income was in excess of twenty thousand dollars ($20,000.00).

Regarding the highest level of education completed, all persons interviewed (100.0%) offered a response. Of this number no one (0.0%) indicated that they did not attend school; 16.0% stated they completed primary/all age school, 9.7% stated that they did not complete high school, 48.4% completed high school, 9.7% college, 9.7% university and 6.5% HEART/Vocational Training Institution.

As it pertained to education, 67.7% of interviewees indicated someone in the household was attending school. As it related to the school being attended 19.0% stated that the school being attended was infant/basic, 61.9% stated primary/all age, 38.1% stated high school, 4.8% college 14.3% university and no one (0.0%) indicated HEART/Vocational Training Institute. It should be noted that percentages will exceed one hundred as multiple persons from households attend school.

When respondents were asked about the presence of recreational spaces in their community 58.1% of those offering a response indicated that a recreational space was present. Recreational spaces named were:

- Green Island High School Field (5.6%)
- Cousins Cove Community Centre (94.4%)

On the issue of respondents' awareness of Princess Hotels and Resorts, all (100.0%) interviewees offered a response. Just over nineteen percent (19.4%) of interviewees stated that they had heard of the hotel, while 80.6% stated that they had not heard of Princess Hotels and Resorts.

Regarding respondents' awareness of proposed hotel construction, all (100%) respondents offered a response. Of these individuals, approximately forty-five percent (45.2%) of individuals stated that they had heard of the proposed project while 54.8% stated that they had never heard of the project. Of the 45.2% of respondents who heard of the project, 7.1% stated television, and 92.9% indicated word of mouth as the medium by which they were made aware.

Regarding what was specifically known/heard about the proposed project, 100.0% stated that they were aware that the hotel was to be built.

As it regarded respondents' awareness of the development of a wastewater treatment plant, all interviewees (100.0%) offered a response. Approximately three percent (3.2%) of interviewees stated that they were aware of the proposed wastewater treatment plant construction while 96.8% stated that they were not aware of this project component. Regarding what was specifically heard, respondents while indicating awareness did not offer specific information nor did they indicate the medium by which they were informed.

As it regarded respondents' awareness of the proposed drainage system, all interviewees (100.0%) offered a response. Approximately three percent (3.2%) of interviewees stated that they were aware of the proposed drainage upgrade while 96.8% stated that they were not aware of this project component. Regarding what was specifically heard, respondents while indicating awareness did not offer specific information nor did they indicate the medium by which they were informed.

As it pertained to respondents' awareness of the whether there have been problems/issues in the Industry Bay area, all (100.0%) respondents offered a response. Of these individuals, no one (0.0%) interviewed indicated that there have been problems/issues in the Industry Bay area while 71.0% stated that there have never been any problems/issues in the area. Twenty-nine percent (29.0%) of respondents stated that they were not aware of any problems/issues in the area.

Regarding whether respondents had any concerns about the project, 100.0% of interviewees offered responses. Of these persons, 19.4% indicated that they had concerns about the project while 77.4% stated that they did not have any concern while 3.2% of respondents indicated that they were not sure if they had any concerns, as they needed more information. Concerns expressed pertained to:

- Wastewater disposal (33.3%)
- Impact on marine life (16.7%)
- Job opportunity (especially for local community) (16.7%)
- Relocation (16.7%)

Some respondents (16.6%) while expressing concern did not provide specific details.

On the issue of whether respondents depended on the proposed location for any business or activity, all (100.0%) interviewees offered a response. Approximately three percent (3.2%) of respondents indicated that they used the proposed location for some type of business or activity while 96.8% stated that they did not use the area for any type of business or activity. Of those who confirmed that they depended on the proposed area (3.2%), individuals stated that they depended on the area for:

- Fishing (100.0%)

As it pertained to respondents' knowing anyone who depended on the proposed area for any type of business or activity, all persons (100.0%) offered a response. Approximately sixteen percent (16.1%) of respondents confirmed that they knew someone who depended on the proposed project area for some type of business of activity, while 83.9% of individuals indicated that they did not know of anyone who depended on the area. Of those who confirmed that they know of someone who depended on the proposed area (16.1%), it was stated that they depended on the area for:

- Fishing (to include vending) (80.0%)
- Recreation (20.0%)

Regarding respondents' opinions on how they anticipated the project to affect their lives, 100.0% of interviewees offered a response. Of these individuals, 35.5% of respondents indicated that the project would not affect their life in any way, while 58.0% anticipated a positive impact. No one (0.0%) anticipated a negative impact. Approximately seven percent (6.5%) were not sure if the project would affect their life.

Regarding the 58.1% of individuals anticipating a positive impact, they anticipated:

- Job opportunities would be created (94.4%)
- Community Development (16.7%)

Percentages exceeded 100.0% as respondents offered multiple responses.

On the issue of how interviewees thought the project would affect the marine life, 96.8% of those interviewed offered a response. Of these, 30.0% indicated that they were unsure about how the marine life would be affected while 46.7% indicated that the marine life would not be affected. No one (0.0%) indicated that the marine life would be positively affected while 23.3% indicated that the project would negatively impact the marine life.

For those anticipating a negative impact on the marine life (23.3%), it was expressed that the construction project would result in:

- Fish migration (42.9%)

- Loss of marine life (flora and fauna) (14.3%)
- Sewage discharge into the ocean (28.6%)

Some respondents (14.2%) while anticipating a negative impact on the marine life did not offer specific details.

On the issue of how interviewees thought the project would affect the general environment, 96.8% of those interviewed offered a response. Of these, 46.7% indicated that they were unsure about how the general environment would be affected while 33.3% indicated that the general environment would not be affected. Just under seven percent (6.7%) indicated that the general environment would be positively affected while 13.3% indicated that the project would negatively impact the general environment.

Of those expecting a positive impact on the general environment (6.7%), one hundred percent (100.0%) stated that they anticipated community development as a positive impact.

For those anticipating a negative impact on the general environment (13.3%), it was expressed that the project would result in:

- Damage to coral reef (25.0%)
- Deforestation (25.0%)
- Loss of marine life (flora and fauna) (25.0%)

Some respondents (25.0%) offered no response.

Regarding how interviewees thought the project would impact flooding in nearby areas, 96.8% of those interviewed offered a response. Of these, 53.4% indicated that they were unsure about how flooding may be impacted while 43.3% indicated that the project would not impact flooding. No one interviewed (0.0%) indicated that there would be a positive impact while 3.3% indicated that the project would negatively impact flooding in nearby areas.

For those anticipating a negative impact on flooding in nearby areas (3.3%), all respondents (100.0%) expressed that the new infrastructure would result in (cause) flooding.

As it related to housing 96.8% of interviewees offered responses. Sixty percent (60.0%) of respondents stated that they owned the house they lived in, 10.0% lived in rented homes, while 26.7% stated that they lived in family owned homes. No one interviewed lived in government owned housing, while 3.3% stated “other” and further advised that they were caretakers overseeing the homes they lived in.

As it pertained to the land on which dwelling homes were located 96.8% of interviewees offered responses. Approximately twenty-seven percent (26.7%) of respondents stated that they owned the land on which the house is located, 10.0% stated that the land was leased, 3.3% had their homes on government owned lands, 3.3% indicated that they squatted on the land, while 46.7% stated that their homes were built on family land, while 10.0% stated “other” and indicated that the home they lived in was rented but there was no arrangement made with respect to the land while some persons indicated that they were caretakers.

Regarding the type of wall that dwellings were made of 77.4% of interviewees indicated that the walls of their homes were made of concrete and blocks while 25.8% stated wood/board. It should be noted that percentages exceeded 100.0% as some respondents indicated that the walls of their homes were made of both concrete and blocks and wood/board materials. This was mainly due to structural additions to increase habitable living space.

Regarding the type of roof that dwellings had, 48.4% of respondents indicated that the roof of their homes was metal sheeting, while 51.6% stated concrete, 6.5% stated wood as the roof material. Percentages exceeded 100.0% as roofs were made of multiple materials, in most instances metal sheeting and concrete. This was due to structural additions to increase habitable living space.

As it pertained to the type of toilet facility present, 93.3% of respondents indicated that their homes had water closets, while 6.7% stated that pit latrine was the toilet facility.

As it related to what the household used for lighting, all respondents (100.0%) stated that electricity was used.

Regarding the type of fuel used mostly for cooking, 96.7% of persons interviewed indicated that gas was used mostly, and 3.3% stated that coal was mostly used as the cooking fuel.

On the issue of the main source of household domestic water supply 90.0% of respondents confirmed that their household domestic water supply was the public piped water supply. Approximately seven percent (6.7%) stated the private tank as the main domestic water supply while 3.3% indicated that the public standpipe was the main source of domestic water supply for the household.

As it pertained to respondents’ having any problems with the domestic water supply, 30.0% of those interviewed indicated that there were problems with the water supply while 70.0% indicated that there were no problems with the domestic water supply. For those persons who confirmed that there were problems with the domestic water supply, 11.1% indicated that there was no water at all, 11.1% also stated that no pipes were run in the area, 33.3% indicated that the water supply was irregular while 22.2% stated that water pressure was low and 11.1 % of respondents stated “other” and indicated that they experienced high turbidity following rainfall events. Some interviewees (11.2%) while indicating that they had problems with their water supply did not offer specific responses.

In response to how persons coped with problems related to domestic/household water supply, of those confirming that there were problems with supply (30.0%), approximately eleven percent (11.1%) of respondents indicated that they stored water, 33.4% indicated that they harvested/collected rain water, 11.1% stated that they bought water, 22.2% also stated that they collected water from a spring or river while 11.1% stated that they used the community standpipe and 11.1% stated that water was supplied by the water truck.

On the issue of access to a residential (fixed line/landline) telephone 70.0% of interviewees indicated that they did not have access to a residential telephone while 30.0% confirmed that they had access. Of the 70.0% of persons indicating that they did not have a fixed line at their residence 100.0% of these individuals indicated that they owned a mobile phone. Additionally, 26.6% of these individuals indicated that they knew of someone who had a fixed-line service.

Regarding the main method of garbage disposal for households, 96.7% of those interviewed indicated that the public garbage truck was the main garbage disposal method while the remaining 3.3% indicated that burning was the main method used to dispose of garbage.

Regarding the frequency of collections of the 96.7% of respondents who indicated that the garbage truck was the main method of garbage disposal, 51.7% indicated that garbage collections were done once per week, 10.3% stated twice per week, 31.0% stated every two weeks, 3.4% stated once per month. Less than one percent (3.6%) of respondents did not indicate the frequency for collections.

When asked about flooding all persons (100.0%) interviewed offered a response. Approximately seven percent (6.5%) of respondents indicated that their community was affected by flooding while 87.0% stated that flooding did not affect their community and 6.5% stated that they did not know if flooding affected their community. Those indicating that their community was affected stated that flooding occurred only during times of heavy rain (100.0%). These respondents also indicated that rain events causing flooding occurred:

- Once monthly (50.0%)
- Once every three months (50.0%)

Affected areas named were:

- Cousins Cove Community

Regarding the height to which water levels rose 100.0% of those confirming that flooding occurred offered a response. Of these respondents, 50.0% stated that water levels were less than 0.3 metre, while 50.0% advised that water levels exceeded 1.5 metres.

Regarding whether there were problems with frequent flooding at or near the proposed site, 51.6% of interviewees, stated that the area was not affected by flooding, while 48.4% stated that they did not know if the area was affected, while no one (0.0%) stated that the area was affected by flooding.

On the issue of whether the proposed area was affected by tidal changes such as sea level rise or storm surge 96.8% of interviewees offered a response. Approximately Fifty-three percent (53.3%) of respondents stated that they did not know if the area was affected while 40.0% stated that the area was not affected by tidal changes and 6.7% indicated that the area was affected by tidal changes.

As it pertained to whether the proposed area was affected by beach erosion in the past 96.8% of interviewees offered a response. Approximately Fifty-seven percent (56.7%) of respondents stated that they did not know if the area was affected while 43.3% stated that the area was not affected by beach erosion in the past. No one interviewed (0.0%) indicated that the area was affected.

Regarding whether there was any site nearby considered to be a protected area, historic area or area of national, historic or environmental importance, 46.7% of interviewees stated they did not know of any such area or site, 50.0% stated that no such area was located near to the proposed area while 3.3% indicated that there was an area/site which was considered to be a protected area or area of historic, national or environmental importance.

Places named were:

- The Turtle Sanctuary in the Industry Cove/Cousins Cove Area

7.1.2.5 Santoy

Nine percent (9.0%) of respondents were from the Santoy community. Approximately sixty-seven percent (66.7%) of respondents were male and 33.3% were female.

Age cohort distribution was as follows; 22.2% were 18-25 years of age, 18.6% were 26-33 years, 22.2% were age 34-41 years, 22.2% were age 42-50 years, 7.4% were age 51-60 years and 7.4% were older than sixty years of age.

Of those persons interviewed who offered a response (100.0%), 29.6% indicated that they were self-employed, while 55.6% stated that they had an employer and 3.7% stated they were unemployed. Approximately eleven percent (11.1%) of individuals were retired. Additionally, 63.0% of interviewees when asked confirmed that they were the head of their household while 37.0% indicated that they were not the household head.

Regarding the number of persons residing in households, twenty-six percent (26.0%) of households had one occupant while 14.8% had two occupants, 14.8% also had three occupants while 18.5% had four persons living in the household. Approximately eleven percent (11.1%) had five persons living in the household and 14.8% of households had more than five persons residing.

In general, interviewees resided in their communities over the long term. Approximately fifty-six percent (55.6%) of individuals resided in their communities for all their life, however no one interviewed (0.0%) resided in their community in excess of fifteen years. Just over twenty-two percent (22.2%) stated they lived in their community for between ten and fifteen years; 14.8% resided for between five and ten years. Just over seven percent (7.4%) resided in their community for between three and five years. No one (0.0%) stated that they resided in their community for under two years.

On the issue of where healthcare was mostly obtained, 18.5% stated the public clinic, 37.0% stated the public hospital and 48.1% stated that healthcare needs were mostly sourced through the private doctor. No one interviewed (0.0%) stated the private hospital. It should be noted that in some instances, respondents offered multiple responses regarding where they mainly went for healthcare, therefore percentages exceeded one hundred.

As it related to whether respondents suffered from specific medical conditions, 14.8% of interviewees indicated that they were asthmatic and 22.2% indicated that they suffered from sinusitis. No one (0.0%) confirmed coughing as an ailment, neither did they state that they suffered from congestion/bronchial problems, chest pains or frequent bouts of diarrhoea. Sixty-three (63.0%) percent of those interviewed indicated that they did not suffer from any of the specific conditions named.

Of those interviewed, just over seven percent (7.4%) of respondents refused to offer a response relating to their personal weekly income. Approximately seven percent (7.4%) of persons indicated that they did not have a weekly income, while no one interviewed (0.0%) indicated that their weekly income was under the previous national minimum wage of $6,200.00 per week. Approximately four percent (3.7%) of interviewees indicated that their weekly income was $6,200.00 per week; 33.4% stated that their weekly income was between $6,201.00-$10,000.00, while 40.7% stated a weekly income ranging between $10,001.00 and $20,000.00. Just over seven percent (7.4%) indicated that their weekly income was in excess of twenty thousand dollars ($20,000.00).

Regarding the highest level of education completed, all persons interviewed (100.0%) offered a response. Of this number no one (0.0%) indicated that they did not attend school; 11.1% stated they completed primary/all age school, 14.8% stated that they did not complete high school, 63.0% completed high school, 0.0% college, 3.7% university and 7.4% HEART/Vocational Training Institution.

As it pertained to education, 51.9% of interviewees indicated someone in the household was attending school. As it related to the school being attended 7.1% stated that the school being attended was infant/basic, 57.1% stated primary/all age, 64.3% stated high school, 7.1% college 7.1% university and 0.0% HEART/Vocational Training Institute. It should be noted that percentages will exceed one hundred as multiple persons from households attend school.

When respondents were asked about the presence of recreational spaces in their community 92.6% of those offering a response indicated that a recreational space was present. Recreational spaces named were:

- Green Island Community Centre (4.0%)
- Santoy Community Centre/ Santoy Road Field/Green Space in Santoy (76.0%)
- Logwood Community Centre/Ball Field (20.0%)

On the issue of respondents' awareness of Princess Hotels and Resorts, all (100.0%) interviewees offered a response. Just under nineteen percent (18.5%) of interviewees stated that they had heard of the hotel, while 81.5% stated that they had not heard of Princess Hotels and Resorts.

Regarding respondents' awareness of proposed hotel construction, all (100%) respondents offered a response. Of these individuals, approximately twenty-six percent (25.9%) of individuals stated that they had heard of the proposed project while 74.1% stated that they had never heard of the project. Of the 25.9% of respondents who heard of the project, 85.7% indicated word of mouth as the medium by which they were made aware. It should be noted that 14.3% of respondents while indicating awareness did not specify the medium by which they were made aware.

Regarding what was specifically known/heard about the proposed project, 85.7% stated that they were aware that the hotel was to be built. Some respondents (14.3%) while indicating awareness did not offer specific information.

As it regarded respondents' awareness of the development of a wastewater treatment plant, all interviewees (100.0%) offered a response. Approximately eleven percent (11.1%) of interviewees stated that they were aware of the proposed wastewater treatment plant construction while 88.9% stated that they were not aware of this project component. Regarding what was specifically heard, 33.3% of those indicating awareness (11.1%) stated that they knew of the proposed construction. Some respondents (66.7%) while indicating awareness did not offer specific information.

Of the 11.1% of respondents who heard of the wastewater treatment plant project, 66.7% indicated word of mouth as the medium by which they were made aware. It should be noted that 33.3% of respondents while indicating awareness did not specify the medium by which they were made aware.

As it regarded respondents' awareness of the proposed drainage system, all interviewees (100.0%) offered a response. Approximately seven percent (7.4%) of interviewees stated that they were aware of the proposed drainage upgrade while 92.6% stated that they were not aware of this project component. Regarding what was specifically heard, these respondents while indicating awareness did not offer specific information.

Of the 7.4% of respondents who heard of the drainage system upgrade, 100.0% indicated word of mouth as the medium by which they were made aware.

As it pertained to respondents' awareness of the whether there have been problems/issues in the Industry Bay area, all (100.0%) respondents offered a response. Of these individuals, no one (0.0%) stated that there have been problems/issues in the Industry Bay area while 77.8% stated that there have never been any problems/issues in the area. Approximately twenty-two percent (22.2%) of respondents stated that they were not aware of any problems/issues in the area.

Regarding whether respondents had any concerns about the project, 100.0% of interviewees offered responses. Of these persons, 7.4% indicated that they had concerns about the project while 92.6% stated that they did not have any concern. Concerns expressed pertained to:

- The project resulting in further road damage (50.0%)
- Wastewater disposal (50.0%)

On the issue of whether respondents depended on the proposed location for any business or activity, all (100.0%) interviewees offered a response. Approximately seven percent (7.4%) of respondents indicated that they used the proposed location for some type of business or activity while 92.6% stated that they did not use the area for any type of business or activity. Of those who confirmed that they depended on the proposed area (7.4%), individuals stated that they depended on the area for:

- To purchase fish (100.0%)

As it pertained to respondents' knowing anyone who depended on the proposed area for any type of business or activity, all persons (100.0%) offered a response. Approximately Thirty percent (29.6%) of respondents confirmed that they knew someone who depended on the proposed project area for some type of business of activity, while 70.4% of individuals indicated that they did not know of anyone who depended on the area. Of those who confirmed that they know of someone who depended on the proposed area (29.6%), it was stated that they depended on the area for:

- Fishing (to include vending) (100.0%)

Regarding respondents' opinions on how they anticipated the project to affect their lives, 100.0% of interviewees offered a response. Of these individuals, 55.6% of respondents indicated that the project would not affect their life in any way, while 40.7% anticipated a positive impact and 0.0% anticipated a negative impact. Just under four percent (3.7%) were not sure if the project would affect their life.

Regarding the 40.7% of individuals anticipating a positive impact, they anticipated:

- Job opportunities would be created (81.8%)
- Community Development (18.2%)
- Increased patronage by tourists (9.1%)

Percentages exceeded 100.0% as respondents offered multiple responses.

On the issue of how interviewees thought the project would affect the marine life, 100.0% of those interviewed offered a response. Of these, 29.6% indicated that they were unsure about how the marine life would be affected while 51.9% indicated that the marine life would not be affected. No one (0.0%) indicated that the marine life would be positively affected while 18.5% indicated that the project would negatively impact the marine life.

For those anticipating a negative impact on the marine life (18.5%), it was expressed that the construction project would result in:

- Fish migration (100.0%)

On the issue of how interviewees thought the project would affect the general environment, 96.3% of those interviewed offered a response. Of these, 53.8% indicated that they were unsure about how the general environment would be affected while 27.0% indicated that the general environment would not be affected. Just under four percent (3.8%) indicated that the general environment would be positively affected while 15.4% indicated that the project would negatively impact the general environment.

Of those expecting a positive impact on the general environment (3.8%), all respondents (100.0%) stated that they anticipated community development as a positive impact.

For those anticipating a negative impact on the general environment (15.4%), it was expressed that the project would result in:

- Increased air pollution (50.0%)
- Introduction of disease into the area by foreigners (25.0%)

Some respondents (25.0%) offered no response.

Regarding how interviewees thought the project would impact flooding in nearby areas, 100.0% of those interviewed offered a response. Of these, 33.3% indicated that they were unsure about how flooding may be impacted while 66.7% indicated that the project would not impact flooding.

As it related to housing 100.0% of interviewees offered responses. Approximately fifty-two percent (51.9%) of respondents stated that they owned the house they lived in, no one (0.0%) stated that their residence was leased, 3.7% lived in rented homes, 3.7% indicated that they squatted in their homes, while 40.7% stated that they lived in family owned homes. No one interviewed lived in government owned housing.

As it pertained to the land on which dwelling homes were located 100.0% of interviewees offered responses. Approximately nineteen percent (18.5%) of respondents stated that they owned the land on which the house is located, 33.4% stated that the land was leased, 3.7% had their homes on government owned lands, 3.7% indicated that they squatted on the land, while 37.0% stated that their homes were built on family land, while 3.7% stated “other” and indicated that the home they lived in was rented but there was no arrangement made with respect to the land.

Regarding the type of wall that dwellings were made of 63.0% of interviewees indicated that the walls of their homes were made of concrete and blocks while 66.7% stated wood/board. It should be noted that percentages exceeded 100.0% as some respondents indicated that the walls of their homes were made of both concrete and blocks and wood/board materials. This was mainly due to structural additions to increase habitable living space.

Regarding the type of roof that dwellings had, 81.5% of respondents indicated that the roof of their homes was metal sheeting, while 25.9% stated concrete, while 3.7% stated “other” but did not specify the roof material. Percentages exceeded 100.0% as roofs were made of multiple materials, in most instances metal sheeting and concrete. This was due to structural additions to increase habitable living space.

As it pertained to the type of toilet facility present, 80.8% of respondents indicated that their homes had water closets, while 19.2% stated that pit latrine was the toilet facility.

As it related to what the household used for lighting, 100.0% of interviewees stated that electricity was used for household lighting.

Regarding the type of fuel used mostly for cooking, 100.0% of persons interviewed indicated that gas was used mostly as the cooking fuel.

On the issue of the main source of household domestic water supply 77.8% of respondents confirmed that their household domestic water supply was the public piped water supply. Approximately twenty-two percent (22.2%) stated the private tank as the main domestic water supply.

As it pertained to respondents' having any problems with the domestic water supply, 11.1% of those interviewed indicated that there were problems with the water supply while 88.6% indicated that there were no problems with the domestic water supply. For those persons who confirmed that there were problems with the domestic water supply, 100.0% indicated that the water supply was irregular while 33.3% stated that water pressure was low. Responses exceeded 100% as some individuals indicated that there were multiple problems being experienced with their water supply.

In response to how persons coped with problems related to domestic/household water supply, of those confirming that there were problems with supply (11.1%), all respondents (100.0%) indicated that they harvested/collected rainwater.

On the issue of access to a residential (fixed line/landline) telephone 85.2% of interviewees indicated that they did not have access to a residential telephone while 14.8% confirmed that they had access. Of the 85.2% of persons indicating that they did not have a fixed line at their residence 95.7% of these individuals indicated that they owned a mobile phone. Additionally, 21.7% of these individuals indicated that they knew of someone who had a fixed-line service.

Regarding the main method of garbage disposal for households, 77.8% of those interviewed indicated that the public garbage truck was the main garbage disposal method while the remaining 22.2% indicated that burning was the main method used to dispose of garbage. No one interviewed stated "private collection" as the main method of garbage disposal for households.

Regarding the frequency of collections, of the 77.8% of respondents who indicated that the garbage truck was the main method of garbage disposal, 71.4% indicated that garbage collections were done once per week, 19.0% stated twice per week, 4.8% stated every two weeks and 4.8% also stated once per month.

When asked about flooding all persons (100.0%) interviewed offered a response. Just over seven percent (7.4%) of respondents indicated that their community was affected by flooding while 92.6% stated that flooding did not affect their community. Those indicating that their community was affected stated that flooding occurred only during times of heavy rain (50.0%), while 50.0% of interviewees did not state when flooding occurred. These respondents also indicated that rain events causing flooding occurred:

- Once every three months (50.0%)

Some respondents (50.0%) did not indicate how often there was a rainfall event to cause flooding.

No affected areas were named.

Regarding the height to which water levels rose 50.0% of those confirming that flooding occurred offered a response. Of these respondents, 100.0% stated that water levels were less than 0.3 metre.

Regarding whether there were problems with frequent flooding at or near the proposed site, 88.9% of interviewees, stated that the area was not affected by flooding, while 7.4% stated that they did not know if the area was affected, while 3.7% stated that the area was affected by flooding. Of the 3.7% of those stating that there were flooding problems, 100.0% stated during hurricanes. These respondents also indicated that rain events causing flooding occurred:

- Less than once per year (100.0%)

No affected areas were named.

Regarding the height to which water levels rose, no responses were received.

On the issue of whether the proposed area was affected by tidal changes such as sea level rise or storm surge 100.0% of interviewees offered a response. Thirty-seven percent (37.0%) of respondents stated that they did not know if the area was affected while 63.0% stated that the area was not affected by tidal changes.

As it pertained to whether the proposed area was affected by beach erosion in the past 100.0% of interviewees offered a response. Approximately Fifty-two percent (51.9%) of respondents stated that they did not know if the area was affected while 48.1% stated that the area was not affected by beach erosion in the past.

Regarding whether there was any site nearby considered to be a protected area, historic area or area of national, historic or environmental importance, 29.6% of interviewees stated they did not know of any such area or site, 66.7% stated that no such area was located near to the proposed area while 3.7% indicated that there was an area/site which was considered to be a protected area or area of historic, national or environmental importance.

Places named were:

- The fish nursery in Green Island

7.1.2.6 Cauldwell

Approximately seven percent (7.3%) of respondents were from the Cauldwell community. Approximately fifty-five percent (54.5%) of respondents were male and 45.5% were female.

Age cohort distribution was as follows; 9.1% were 18-25 years of age, 9.1% were 26-33 years, 36.3% were age 34-41 years, 18.2% were age 42-50 years, 9.1% were age 51-60 years and 18.2% were older than sixty years of age.

Of those persons interviewed who offered a response (100.0%), 54.5% indicated that they were self-employed, while 18.3% stated that they had an employer and 13.6% stated they were unemployed. Approximately fourteen percent (13.6%) of individuals were retired. Additionally, 77.3% of interviewees when asked confirmed that they were the head of their household while 22.7% indicated that they were not the household head.

Regarding the number of persons residing in households, approximately twenty-seven percent (27.3%) of households had one occupant while 18.2% had two occupants, 9.1% had three occupants while 31.8% had four persons living in the household. Just over nine percent (9.1%) had five persons living in the household and 4.5% of households had more than five persons residing.

In general, interviewees resided in their communities over the long term. Approximately sixty-four percent (63.7%) of individuals resided in their communities for all their life, and 13.6% resided in their community in excess of fifteen years. Approximately fourteen percent (13.6%) stated they lived in their community for between ten and fifteen years; 9.1% resided for between five and ten years. No one interviewed (0.0%) resided in their community for less than five years.

On the issue of where healthcare was mostly obtained, 4.5% stated the public clinic, 50.0% stated the public hospital and 45.5% stated that healthcare needs were mostly sourced through the private doctor. No one interviewed (0.0%) stated the private hospital.

As it related to whether respondents suffered from specific medical conditions, 13.7% of interviewees indicated that they were asthmatic, 4.5% indicated that they suffered from sinusitis, 4.5% also confirmed coughing as an ailment, while 4.5% indicated that they suffered from congestion/bronchial problems. Approximately five percent (4.5%) indicated that they suffered from chest pains while 0.0% of those interviewed confirmed frequent bouts of diarrhoea. Approximately sixty-eight (68.3%) percent of those interviewed indicated that they did not suffer from any of the specific conditions named.

Of those interviewed, just under twenty-seven percent (27.3%) of respondents refused to offer a response relating to their personal weekly income. Approximately fourteen percent (13.7%) of persons indicated that they did not have a weekly income, while 4.5% indicated that their weekly income was under the previous national minimum wage of $6,200.00 per week. Approximately nine percent (9.1%) of interviewees indicated that their weekly income was $6,200.00 per week; 22.7% stated that their weekly income was between $6,201.00-$10,000.00, while 18.2% stated a weekly income ranging between $10,001.00 and $20,000.00. Just over five percent (4.5%) indicated that their weekly income was in excess of twenty thousand dollars ($20,000.00).

Regarding the highest level of education completed, all persons interviewed (100.0%) offered a response. Of this number approximately five percent (4.6%) indicated that they did not attend school; 22.7% stated they completed primary/all age school, 18.2% stated that they did not complete high school, 50.0% completed high school, 0.0% college, 4.5% university and 0.0% HEART/Vocational Training Institution.

As it pertained to education, 59.1% of interviewees indicated someone in the household was attending school. As it related to the school being attended 46.2% stated that the school being attended was infant/basic, 38.5% stated primary/all age, 23.1% stated high school, 0.0% college 0.0% university and 15.4% HEART/Vocational Training Institute. It should be noted that percentages will exceed one hundred as multiple persons from households attend school.

When respondents were asked about the presence of recreational spaces in their community 90.1% of those offering a response indicated that a recreational space was present. Recreational spaces named were:

- Cauldwell Community Centre (35.0%) (now occupied by the military since the SOE)
- Pell River Community Centre/Ball Field (50.0%)
- Friendship Greenspace (10.0%)
- Grange Greenspace (5.0%)

On the issue of respondents' awareness of Princess Hotels and Resorts, all (100.0%) interviewees offered a response. Just over eighteen percent (18.2%) of interviewees stated that they had heard of the hotel, while 81.8% stated that they had not heard of Princess Hotels and Resorts.

Regarding respondents' awareness of proposed hotel construction, all (100%) respondents offered a response. Of these individuals, approximately thirty-two percent (31.8%) of individuals stated that they had heard of the proposed project while 68.2% stated that they had never heard of the project. Of the 31.8% of respondents who heard of the project, 14.3% of interviewees stated they were made aware via community meeting and 71.4% indicated word of mouth as the medium by which they were made aware, while 14.3% stated "other" and further stated that they were made aware by direct observation.

Regarding what was specifically known/heard about the proposed project, 100.0% stated that they were aware that the hotel was to be built.

As it regarded respondents' awareness of the development of a wastewater treatment plant, all interviewees (100.0%) offered a response. Approximately five percent (4.5%) of interviewees stated that they were aware of the proposed wastewater treatment plant construction while 95.5% stated that they were not aware of this project component. Regarding what was specifically heard, all (100.0%) of those indicating awareness (4.5%) stated that they knew of the proposed construction.

Of the 4.5% of respondents who heard of the wastewater treatment plant project, 100.0% indicated word of mouth as the medium by which they were made aware.

As it regarded respondents' awareness of the proposed drainage system, all interviewees (100.0%) offered a response. Approximately five percent (4.5%) of interviewees stated that they were aware of the proposed drainage upgrade while 95.5% stated that they were not aware of this project component. Regarding what was specifically heard, all (100.0%) of those indicating awareness (4.5%) stated that they knew of the proposed drainage system upgrade.

Of the 4.5% of respondents who heard of the drainage system upgrade, 100.0% indicated word of mouth as the medium by which they were made aware.

As it pertained to respondents' awareness of the whether there have been problems/issues in the Industry Bay area, all (100.0%) respondents offered a response. Of these individuals, no one (0.0%) stated that there have been problems/issues in the Industry Bay area while 81.8% stated that there have never been any problems/issues in the area. Just over eighteen percent (18.2%) of respondents stated that they were not aware of any problems/issues in the area.

Regarding whether respondents had any concerns about the project, 100.0% of interviewees offered responses. Of these persons, 27.3% indicated that they had concerns about the project while 68.2% stated that they did not have any concern while 4.5% of respondents indicated that they were not sure if they had any concerns, as they needed more information. Concerns expressed pertained to:

- Wastewater disposal (16.7%)
- Job opportunity (especially for local community) (16.7%)
- When the project would commence (16.7%)
- The project attracting criminal elements during construction phase (33.2%)
- The location of the wastewater treatment plant (16.7%)

On the issue of whether respondents depended on the proposed location for any business or activity, all (100.0%) interviewees offered a response and further that they did not use the area for any type of business or activity.

As it pertained to respondents' knowing anyone who depended on the proposed area for any type of business or activity, all persons (100.0%) offered a response. Approximately nine percent (9.1%) of respondents confirmed that they knew someone who depended on the proposed project area for some type of business of activity, while 90.0% of individuals indicated that they did not know of anyone who depended on the area. Of those who confirmed that they know of someone who depended on the proposed area (9.1%), it was stated that they depended on the area for:

- Fishing (to include vending) (100.0%)

Regarding respondents' opinions on how they anticipated the project to affect their lives, 95.5% of interviewees offered a response. Of these individuals, 33.3 of respondents indicated that the project would not affect their life in any way, while 47.6% anticipated a positive impact and 4.8% anticipated a negative impact. Just over fourteen percent (14.3%) were not sure if the project would affect their life.

Regarding the 47.6% of individuals anticipating a positive impact, they anticipated:

- Job opportunities would be created (90.0%)
- Community Development (20.0%)

Percentages exceeded 100.0% as respondents offered multiple responses.

As it pertained to the 4.8% of interviewees who indicated that they thought the project would affect their lives negatively, they anticipated:

- Influx of criminal elements during construction phase (100.0%)

On the issue of how interviewees thought the project would affect the marine life, 100.0% of those interviewed offered a response. Of these, 36.4% indicated that they were unsure about how the marine life would be affected while 45.5% indicated that the marine life would not be affected. Less than five percent (4.5%) indicated that the marine life would be positively affected while 13.6% indicated that the project would negatively impact the marine life.

Of those expecting a positive impact on the marine life (4.5%), no one interviewed offered a specific response.

For those anticipating a negative impact on the marine life (13.6%), it was expressed that the construction project would result in:

- Loss of marine life (flora and fauna) (33.3%)
- Improper solid waste disposal (specifically into the ocean) (66.7%)

On the issue of how interviewees thought the project would affect the general environment, 95.5% of those interviewed offered a response. Of these, 42.9% indicated that they were unsure about how the general environment would be affected while 33.3% indicated that the general environment would not be affected. Just under twenty-four percent (23.8%) indicated that the general environment would be positively affected while 0.0% indicated that the project would negatively impact the general environment.

Of those expecting a positive impact on the general environment (23.8%), sixty percent (60.0%) stated that they anticipated community development as a positive impact. The remaining 40.0% offered no specific information.

Regarding how interviewees thought the project would impact flooding in nearby areas, 100.0% of those interviewed offered a response. Of these, 40.9% indicated that they were unsure about how flooding may be impacted while 59.1% indicated that the project would not impact flooding. No one (0.0%) indicated that there would be a positive impact and similarly no one (0.0%) indicated that the project would negatively impact flooding in nearby areas.

As it related to housing 100.0% of interviewees offered responses. Approximately sixty-four percent (63.6%) of respondents stated that they owned the house they lived in, 22.8% lived in rented homes, 4.5% indicated that they squatted in their homes, while 9.1% stated that they lived in family owned homes.

As it pertained to the land on which dwelling homes were located 100.0% of interviewees offered responses. Approximately nine percent (9.1%) of respondents stated that they owned the land on which the house is located, 13.6% stated that the land was leased, 9.1% had their homes on government owned lands, 9.1% indicated that they squatted on the land, while 40.9% stated that their homes were built on family land, while 18.2% stated "other" and indicated that the home they lived in was rented but there was no arrangement made with respect to the land.

Regarding the type of wall that dwellings were made of 31.8% of interviewees indicated that the walls of their homes were made of concrete and blocks while 72.7% stated wood/board. It should be noted that percentages exceeded 100.0% as some respondents indicated that the walls of their homes were made of both concrete and blocks and wood/board materials. This was mainly due to structural additions to increase habitable living space.

Regarding the type of roof that dwellings had, 81.8% of respondents indicated that the roof of their homes was metal sheeting, while 18.2% stated concrete.

As it pertained to the type of toilet facility present, 72.7% of respondents indicated that their homes had water closets, while 27.3% stated that pit latrine was the toilet facility.

As it related to what the household used for lighting, 90.9% of interviewees stated that electricity was used while 9.1% stated kerosene oil.

Regarding the type of fuel used mostly for cooking, 63.6% of persons interviewed indicated that gas was used mostly, 27.4% stated electricity as the main cooking fuel, while 4.5% stated that they mostly used wood for cooking and 4.5% stated that coal was mostly used as the cooking fuel.

On the issue of the main source of household domestic water supply 72.7% of respondents confirmed that their household domestic water supply was the public piped water supply. Approximately twenty-three percent (22.7%) stated the private tank as the main domestic water supply. Approximately five percent of respondents (4.6%) stated “other” as the main source of household domestic water and further advised that they harvested rainwater.

As it pertained to respondents’ having any problems with the domestic water supply, 18.2% of those interviewed indicated that there were problems with the water supply while 81.8% indicated that there were no problems with the domestic water supply. For those persons who confirmed that there were problems with the domestic water supply, 100.0% indicated that the water supply was irregular.

In response to how persons coped with problems related to domestic/household water supply, of those confirming that there were problems with supply (18.2%), twenty-five percent (25.0%) of respondents indicated that they stored water, 50.0% stated that they bought water, 50.0% also stated that they collected water from a spring or river. Responses exceeded 100% as some individuals indicated that they addressed the problems in multiple ways.

On the issue of access to a residential (fixed line/landline) telephone 95.5% of interviewees indicated that they did not have access to a residential telephone while 4.5% confirmed that they had access. Of the 95.5% of persons indicating that they did not have a fixed line at their residence 85.7% of these individuals indicated that they owned a mobile phone. Additionally, 14.3% of these individuals indicated that they knew of someone who had a fixed-line service.

Regarding the main method of garbage disposal for households, 68.2% of those interviewed indicated that the public garbage truck was the main garbage disposal method while the remaining 31.8% indicated that burning was the main method used to dispose of garbage. No one interviewed stated “private collection” as the main method of garbage disposal for households.

Regarding the frequency of collections of the 68.2% of respondents who indicated that the garbage truck was the main method of garbage disposal, 13.4% indicated that garbage collections were done once per week, 6.7% stated twice per week, 33.3% stated every two weeks, 33.3% stated once per month, 13.3% stated less than once per month.

When asked about flooding all persons (100.0%) interviewed offered a response and further stated that flooding did not affect their community.

Regarding whether there were problems with frequent flooding at or near the proposed site, 59.1% of interviewees, stated that the area was not affected by flooding, while 40.9% stated that they did not know if the area was affected, while no one (0.0%) stated that the area was affected by flooding.

On the issue of whether the proposed area was affected by tidal changes such as sea level rise or storm surge 100.0% of interviewees offered a response. Forty-one percent (41.0%) of respondents stated that they did not know if the area was affected while 54.5% stated that the area was not affected by tidal changes and 4.5% indicated that the area was affected by tidal changes.

As it pertained to whether the proposed area was affected by beach erosion in the past 100.0% of interviewees offered a response. Approximately seventy-three percent (72.7%) of respondents stated that they did not know if the area was affected while 22.8% stated that the area was not affected by beach erosion in the past and 4.5% indicated that the area was affected.

Regarding whether there was any site nearby considered to be a protected area, historic area or area of national, historic or environmental importance, 31.8% of interviewees stated they did not know of any such area or site, 68.2% stated that no such area was located near to the proposed area while no one (0.0%) indicated that there was an area/site which was considered to be a protected area or area of historic, national or environmental importance.

7.1.2.7 Davis Cove and Spring Valley

Approximately seven percent (6.7%) of respondents were from the Davis Cove (3.0%) and Spring Valley (3.7%) communities. Fifty percent (50.0%) of respondents were male and 50.0% were female.

Age cohort distribution was as follows; 25.0% were 18-25 years of age, 10.0% were 26-33 years, 30.0% were age 34-41 years, 20.0% were age 42-50 years, 5.0% were age 51-60 years and 10.0% were older than sixty years of age.

Of those persons interviewed who offered a response (100.0%), 30.0% indicated that they were self-employed, while 55.0% stated that they had an employer and 5.0% stated they were unemployed. Ten percent (10.0%) of individuals were retired. Additionally, 80.0% of interviewees when asked confirmed that they were the head of their household while 20.0% indicated that they were not the household head.

Regarding the number of persons residing in households, ten percent (10.0%) of households had one occupant while 35.0% had two occupants, 15.0% had three occupants while 20.0% had four persons living in the household. Ten percent (10.0%) had five persons living in the household and 10.0% of households also had more than five persons residing.

In general, interviewees resided in their communities over the long term. Forty percent (40.0%) of individuals resided in their communities for all their life, and 15.0% resided in their community in excess of fifteen years. Thirty percent (30.0%) stated they lived in their community for between ten and fifteen years; 5.0% resided for between five and ten years. Ten percent (10.0%) resided in their community for between three and five years while no one (0.0%) resided in the community for under two years.

On the issue of where healthcare was mostly obtained, 25.0% stated the public clinic, 20.0% stated the public hospital and 55.0% stated that healthcare needs were mostly sourced through the private doctor.

As it related to whether respondents suffered from specific medical conditions, 10.0% of interviewees indicated that they were asthmatic and 20.0% indicated that they suffered from sinusitis. Five percent (5.0%) indicated that they suffered from chest pains Seventy (70.0%) percent of those interviewed indicated that they did not suffer from any of the specific conditions named. It should be noted that in some instances, respondents suffered from more than one of the listed ailments, therefore percentages exceeded one hundred.

Of those interviewed, ten percent (10.0%) of respondents refused to offer a response relating to their personal weekly income. Five percent (5.0%) of persons indicated that they did not have a weekly income, while no one interviewed (0.0%) indicated that their weekly income was under the previous national minimum wage of $6,200.00 per week. Five percent (5.0%) of interviewees indicated that their weekly income was $6,200.00 per week; 15.0% stated that their weekly income was between $6,201.00-$10,000.00, while 50.0% stated a weekly income ranging between $10,001.00 and $20,000.00. Fifteen percent (15.0%) indicated that their weekly income was in excess of twenty thousand dollars ($20,000.00).

Regarding the highest level of education completed, all persons interviewed (100.0%) offered a response. Of this number no one interviewed (0.0%) indicated that they did not attend school; 10.0% stated they completed primary/all age school, 15.0% stated that they did not complete high school, 65.0% completed high school, 0.0% college, 0.0% university and 10.0% HEART/Vocational Training Institution.

As it pertained to education, 55.0% of interviewees indicated someone in the household was attending school. As it related to the school being attended 27.3% stated that the school being attended was infant/basic, 63.6% stated primary/all age, 45.5% stated high school, 0.0% college, 0.0% university and 0.0% HEART/Vocational Training Institute. It should be noted that percentages will exceed one hundred as multiple persons from households attend school.

When respondents were asked about the presence of recreational spaces in their community 65.0% of those offering a response indicated that a recreational space was present. Recreational spaces named were:

- Cousins Cove Community Centre (15.4%)
- Spring Valley Greenspace (84.6%)

On the issue of respondents' awareness of Princess Hotels and Resorts, all (100.0%) interviewees offered a response. Fifteen percent (15.0%) of interviewees stated that they had heard of the hotel, while 85.0% stated that they had not heard of Princess Hotels and Resorts.

Regarding respondents' awareness of proposed hotel construction, all (100%) respondents offered a response. Of these individuals, fifteen percent (15.0%) of individuals stated that they had heard of the proposed project while 85.0% stated that they had never heard of the project. Of the 15.0% of respondents who heard of the project, 100.0% stated they were made aware via word of mouth as the medium by which they were made aware.

Regarding what was specifically known/heard about the proposed project, 66.7% stated that they were aware that the hotel was to be built. Some respondents (33.3%) while indicating awareness did not offer specific information.

As it regarded respondents' awareness of the development of a wastewater treatment plant, all interviewees (100.0%) offered a response. Five percent (5.0%) of interviewees stated that they were aware of the proposed wastewater treatment plant construction while 95.0% stated that they were not aware of this project component. Regarding what was specifically heard, these respondents while indicating awareness did not offer specific information.

Of the 5.0% of respondents who heard of the wastewater treatment plant project, 100.0% indicated word of mouth as the medium by which they were made aware.

As it regarded respondents' awareness of the proposed drainage system, all interviewees (100.0%) offered a response. Five percent (5.0%) of interviewees stated that they were aware of the proposed drainage upgrade while 95.0% stated that they were not aware of this project component. Regarding what was specifically heard, these respondents while indicating awareness did not offer specific information.

Of the 5.0% of respondents who heard of the drainage system upgrade, 100.0% indicated word of mouth as the medium by which they were made aware.

As it pertained to respondents' awareness of the whether there have been problems/issues in the Industry Bay area, all (100.0%) respondents offered a response. Of these individuals, no one interviewed (0.0%) stated that there have been problems/issues in the Industry Bay area while 80.0% stated that there have never been any problems/issues in the area. Twenty percent (20.0%) of respondents stated that they were not aware of any problems/issues in the area.

Regarding whether respondents had any concerns about the project, 100.0% of interviewees offered responses. Of these persons, no one (0.0%) indicated that they had concerns about the project while 95.0% stated that they did not have any concern while 5.0% of respondents indicated that they were not sure if they had any concerns, as they needed more information.

On the issue of whether respondents depended on the proposed location for any business or activity, all (100.0%) interviewees offered a response. Fifteen percent (15.0%) of respondents indicated that they used the proposed location for some type of business or activity while 85.0% stated that they did not use the area for any type of business or activity. Of those who confirmed that they depended on the proposed area (15.0%), individuals stated that they depended on the area for:

- To purchase fish (100.0%)

As it pertained to respondents' knowing anyone who depended on the proposed area for any type of business or activity, all persons (100.0%) offered a response. Thirty percent (30.0%) of respondents confirmed that they knew someone who depended on the proposed project area for some type of business of activity, while 70.0% of individuals indicated that they did not know of anyone who depended on the area. Of those who confirmed that they know of someone who depended on the proposed area (30.0%), it was stated that they depended on the area for:

- Fishing (to include vending) (100.0%)

Regarding respondents' opinions on how they anticipated the project to affect their lives, 100.0% of interviewees offered a response. Of these individuals, 50.0% of respondents indicated that the project would not affect their life in any way, while 30.0% anticipated a positive impact and 0.0% anticipated a negative impact. Twenty percent (20.0%) were not sure if the project would affect their life.

Regarding the 50.0% of individuals anticipating a positive impact, they anticipated:

- Job opportunities would be created (100.0%)

On the issue of how interviewees thought the project would affect the marine life, 100.0% of those interviewed offered a response. Of these, 25.0% indicated that they were unsure about how the marine life would be affected while 40.0% indicated that the marine life would not be affected. No one (0.0%) indicated that the marine life would be positively affected while 35.0% indicated that the project would negatively impact the marine life.

For those anticipating a negative impact on the marine life (35.0%), it was expressed that the construction project would result in:

- Fish migration (100.0%)

On the issue of how interviewees thought the project would affect the general environment, 100.0% of those interviewed offered a response. Of these, 50.0% indicated that they were unsure about how the general environment would be affected while 30.0% indicated that the general environment would not be affected. Fifteen percent (15.0%) indicated that the general environment would be positively affected while 5.0% indicated that the project would negatively impact the general environment.

Of those expecting a positive impact on the general environment (15.0%), all respondents (100.0%) stated that they anticipated community development as a positive impact.

For those anticipating a negative impact on the general environment (5.0%), it was expressed that the project would result in:

- Increased air pollution (100.0%)

Regarding how interviewees thought the project would impact flooding in nearby areas, 100.0% of those interviewed offered a response. Of these, 25.0% indicated that they were unsure about how flooding may be impacted while 75.0% indicated that the project would not impact flooding. No one (0.0%) indicated that there would be a positive impact and similarly no one (0.0%) indicated that the project would negatively impact flooding in nearby areas.

As it related to housing 100.0% of interviewees offered responses. Fifty-five percent (55.0%) of respondents stated that they owned the house they lived in, 5.0% stated that their residence was leased, 10.0% lived in rented homes, 0.0% indicated that they squatted in their homes, while 30.0% stated that they lived in family owned homes.

As it pertained to the land on which dwelling homes were located 100.0% of interviewees offered responses. Twenty-five percent (25.0%) of respondents stated that they owned the land on which the house is located, 20.0% stated that the land was leased, 0.0% had their homes on government owned lands, 5.0% indicated that they squatted on the land, while 40.0% stated that their homes were built on family land, while 10.0% stated "other" and indicated that the home they lived in was rented but there was no arrangement made with respect to the land.

Regarding the type of wall that dwellings were made of 55.0% of interviewees indicated that the walls of their homes were made of concrete and blocks while 50.0% stated wood/board and 5.0% stated zinc. It should be noted that percentages exceeded 100.0% as some respondents indicated that the walls of their homes were made of both concrete and blocks and wood/board materials. This was mainly due to structural additions to increase habitable living space.

Regarding the type of roof that dwellings had, 60.0% of respondents indicated that the roof of their homes was metal sheeting, while 45.0% stated concrete, 1.0% stated wood as the roof material. Percentages exceeded 100.0% as roofs were made of multiple materials, in most instances metal sheeting and concrete. This was due to structural additions to increase habitable living space.

As it pertained to the type of toilet facility present, 85.0% of respondents indicated that their homes had water closets, while 15.0% stated that pit latrine was the toilet facility.

As it related to what the household used for lighting, 100.0% of interviewees stated that electricity was used for household lighting.

Regarding the type of fuel used mostly for cooking, 1000% of persons interviewed indicated that gas was used mostly.

On the issue of the main source of household domestic water supply 80.0% of respondents confirmed that their household domestic water supply was the public piped water supply. Twenty percent (20.0%) stated the private tank as the main domestic water supply.

As it pertained to respondents' having any problems with the domestic water supply, 10.0% of those interviewed indicated that there were problems with the water supply while 90.0% indicated that there were no problems with the domestic water supply. For those persons who confirmed that there were problems with the domestic water supply, 100.0% indicated that the water supply was irregular.

In response to how persons coped with problems related to domestic/household water supply, of those confirming that there were problems with supply (20.0%), all individuals (100.0%) stated that they collected water from a spring or river.

On the issue of access to a residential (fixed line/landline) telephone 65.0% of interviewees indicated that they did not have access to a residential telephone while 35.0% confirmed that they had access. Of the 65.0% of persons indicating that they did not have a fixed line at their residence 100.0% of these individuals indicated that they owned a mobile phone. Additionally, 46.2% of these individuals indicated that they knew of someone who had a fixed-line service.

Regarding the main method of garbage disposal for households, 85.0% of those interviewed indicated that the public garbage truck was the main garbage disposal method while the remaining 15.0% indicated that burning was the main method used to dispose of garbage.

Regarding the frequency of collections of the 85.0% of respondents who indicated that the garbage truck was the main method of garbage disposal, 35.3% indicated that garbage collections were done once per week, 5.9% stated twice per week, 35.3% stated every two weeks, 17.6% stated once per month, 5.9% stated less than once per month.

When asked about flooding all persons (100.0%) interviewed offered a response and further stated that flooding did not affect their community.

Regarding whether there were problems with frequent flooding at or near the proposed site, 80.0% of interviewees, stated that the area was not affected by flooding, while 20.0% stated that they did not know if the area was affected, while no one interviewed (0.0%) stated that the area was affected by flooding.

On the issue of whether the proposed area was affected by tidal changes such as sea level rise or storm surge 100.0% of interviewees offered a response. Eighty percent (80.0%) of respondents stated that they did not know if the area was affected while 20.0% stated that the area was not affected by tidal changes. No one (0.0%) indicated that the area was affected by tidal changes.

As it pertained to whether the proposed area was affected by beach erosion in the past 100.0% of interviewees offered a response. Seventy-five percent (75.0%) of respondents stated that they did not know if the area was affected while 25.0% stated that the area was not affected by beach erosion in the past. No one (0.0%) indicated that the area was affected.

Regarding whether there was any site nearby considered to be a protected area, historic area or area of national, historic or environmental importance, 40.0% of interviewees stated they did not know of any such area or site, 60.0% stated that no such area was located near to the proposed area while no interviewee (0.0%) indicated that there was an area/site which was considered to be a protected area or area of historic, national or environmental importance.

7.1.2.8 Spring Mountain and Woodchurch

Just over seven percent (7.3%) of respondents were from the Spring Mountain (2.3%) and Woodchurch (5.0%) communities. Approximately forty-one percent (40.9%) of respondents were male and 59.1% were female.

Age cohort distribution was as follows; 13.6% were 18-25 years of age, 27.3% were 26-33 years, 27.3% were age 34-41 years, 18.2% were age 42-50 years, 13.6% were age 51-60 years; no one (0.0%) was older than sixty years of age.

Of those persons interviewed who offered a response (100.0%), 36.4% indicated that they were self-employed, while 36.4% stated that they had an employer and 27.2% stated they were unemployed. No individuals interviewed (0.0%) were retired. Additionally, 54.5% of interviewees when asked confirmed that they were the head of their household while 45.5% indicated that they were not the household head.

Regarding the number of persons residing in households, approximately fourteen percent (13.6%) of households had one occupant while 27.4% had two occupants, 31.8% had three occupants while 13.6% had four persons living in the household. Just over nine percent (9.1%) had five persons living in the household and 4.5% of households had more than five persons residing.

In general, interviewees resided in their communities over the long term. Approximately forty-six percent (45.5%) of individuals resided in their communities for all their life, and 4.5% resided in their community in excess of fifteen years. Approximately twenty-three percent (22.7%) stated they lived in their community for between ten and fifteen years; 18.3% resided for between five and ten years. Approximately five percent (4.5%) resided in their community for between three and five years and similarly 4.5% for under two years.

On the issue of where healthcare was mostly obtained, 22.7% stated the public clinic, 31.8% stated the public hospital and similarly 68.2% stated that healthcare needs were mostly sourced through the private doctor. It should be noted that in some instances, respondents offered multiple responses regarding where they mainly went for healthcare, therefore percentages exceeded one hundred.

As it related to whether respondents suffered from specific medical conditions, 13.6% of interviewees indicated that they were asthmatic and 13.6% also indicated that they suffered from sinusitis. Approximately eighty-two (81.8%) percent of those interviewed indicated that they did not suffer from any of the specific conditions named. It should be noted that in some instances, respondents suffered from more than one of the listed ailments, therefore percentages exceeded one hundred.

Of those interviewed, no one (0.0%) refused to offer a response relating to their personal weekly income. Approximately twenty-three percent (22.8%) of persons indicated that they did not have a weekly income, while no one (0.0%) indicated that their weekly income was under the previous national minimum wage of $6,200.00 per week. Approximately five percent (4.5%) of interviewees indicated that their weekly income was $6,200.00 per week; 22.7% stated that their weekly income was between $6,201.00-$10,000.00, while 45.5% stated a weekly income ranging between $10,001.00 and $20,000.00. Approximately five percent (4.5%) indicated that their weekly income was in excess of twenty thousand dollars ($20,000.00).

Regarding the highest level of education completed, all persons interviewed (100.0%) offered a response. Of this number no one (0.0%) indicated that they did not attend school, similarly no one (0.0%) stated their highest level of education was primary/all age school, however 9.1% stated that they did not complete high school, 63.6% completed high school, 0.0% college, 4.5% university and 22.8% HEART/Vocational Training Institution.

As it pertained to education, 36.4% of interviewees indicated someone in the household was attending school. As it related to the school being attended 12.5% stated that the school being attended was infant/basic, 50.0% stated primary/all age, 37.5% stated high school, 0.0% college 0.0% university and 25.0% HEART/Vocational Training Institute. It should be noted that percentages will exceed one hundred as multiple persons from households attend school.

When respondents were asked about the presence of recreational spaces in their community 31.8% of those offering a response indicated that a recreational space was present. Recreational spaces named were:

- Friendship Greenspace (14.3%)
- Kingsvale Playing Field (85.7%)

On the issue of respondents' awareness of Princess Hotels and Resorts, all (100.0%) interviewees offered a response and further stated that they had not heard of Princess Hotels and Resorts.

As it regarded respondents' awareness of the development of a wastewater treatment plant, all interviewees (100.0%) offered a response and further stated that they were not aware of this project component.

As it regarded respondents' awareness of the proposed drainage system, all interviewees (100.0%) offered a response and stated that they were not aware of this project component.

As it pertained to respondents' awareness of the whether there have been problems/issues in the Industry Bay area, all (100.0%) respondents offered a response. Of these individuals, no one interviewed (0.0%) stated that there have been problems/issues in the Industry Bay area while 22.7% stated that there have never been any problems/issues in the area. Approximately seventy-seven percent (77.3%) of respondents stated that they were not aware of any problems/issues in the area.

Regarding whether respondents had any concerns about the project, 100.0% of interviewees offered responses. Of these persons, 9.1% indicated that they had concerns about the project while 59.1% stated that they did not have any concern while 31.8% of respondents indicated that they were not sure if they had any concerns, as they needed more information. Concerns expressed pertained to:

- Job opportunity (especially for local community) (100.0%)

On the issue of whether respondents depended on the proposed location for any business or activity, all (100.0%) interviewees offered a response. Approximately five percent (4.5%) of respondents indicated that they used the proposed location for some type of business or activity while 95.5% stated that they did not use the area for any type of business or activity. Of those who confirmed that they depended on the proposed area (4.5%), individuals stated that they depended on the area for:

- Fishing (100.0%)

As it pertained to respondents' knowing anyone who depended on the proposed area for any type of business or activity, all persons (100.0%) offered a response. Approximately five percent (4.5%) of respondents confirmed that they knew someone who depended on the proposed project area for some type of business of activity, while 95.5% of individuals indicated that they did not know of anyone who depended on the area. Of those who confirmed that they know of someone who depended on the proposed area (4.5%), it was stated that they depended on the area for:

- Fishing (to include vending) (100.0%)

Regarding respondents' opinions on how they anticipated the project to affect their lives, 100.0% of interviewees offered a response. Of these individuals, 36.4% of respondents indicated that the project would not affect their life in any way, while 31.8% anticipated a positive impact and no one (0.0%) anticipated a negative impact. Just under thirty-two percent (31.8%) were not sure if the project would affect their life.

Regarding the 31.8% of individuals anticipating a positive impact, they anticipated:

- Job opportunities would be created (100.0%)

On the issue of how interviewees thought the project would affect the marine life, 100.0% of those interviewed offered a response. Of these, 40.9% indicated that they were unsure about how the marine life would be affected while 59.1% indicated that the marine life would not be affected. No one (0.0%) indicated that the marine life would be positively affected and similarly no one indicated that the project would negatively impact the marine life.

On the issue of how interviewees thought the project would affect the general environment, 100.0% of those interviewed offered a response. Of these, 13.6% indicated that they were unsure about how the general environment would be affected while 86.4% indicated that the general environment would not be affected. No one (0.0%) indicated that the marine life would be positively affected and similarly no one indicated that the project would negatively impact the marine life.

Regarding how interviewees thought the project would impact flooding in nearby areas, 100.0% of those interviewed offered a response. Of these, 90.9% indicated that they were unsure about how flooding may be impacted while 9.1% indicated that the project would not impact flooding. No one (0.0%) indicated that there would be a positive impact and similarly no one indicated that the project would negatively impact flooding in nearby areas.

As it related to housing 100.0% of interviewees offered responses. Fifty percent (50.0%) of respondents stated that they owned the house they lived in, no one (0.0%) stated that their residence was leased, 4.5% lived in rented homes, while 45.5% stated that they lived in family owned homes.

As it pertained to the land on which dwelling homes were located 100.0% of interviewees offered responses. Approximately thirty-seven percent (36.5%) of respondents stated that they owned the land on which the house is located, no one (0.0%) stated that the land was leased, nor indicated that their homes were on government owned lands, 4.5% indicated that they squatted on the land, while 54.5%

stated that their homes were built on family land, while 4.5% stated “other” and indicated that the home they lived in was rented but there was no arrangement made with respect to the land.

Regarding the type of wall that dwellings were made of 36.4% of interviewees indicated that the walls of their homes were made of concrete and blocks while 72.7% stated wood/board. It should be noted that percentages exceeded 100.0% as some respondents indicated that the walls of their homes were made of both concrete and blocks and wood/board materials. This was mainly due to structural additions to increase habitable living space.

Regarding the type of roof that dwellings had, 77.3 of respondents indicated that the roof of their homes was metal sheeting, while 31.8% stated concrete. Percentages exceeded 100.0% as roofs were made of multiple materials, in most instances metal sheeting and concrete. This was due to structural additions to increase habitable living space.

As it pertained to the type of toilet facility present, 95.5% of respondents indicated that their homes had water closets, while 4.5% stated that pit latrine was the toilet facility.

As it related to what the household used for lighting, 100.0% of interviewees stated that electricity was used.

Regarding the type of fuel used mostly for cooking, 100.0% of persons interviewed indicated that gas was used mostly as the cooking fuel.

On the issue of the main source of household domestic water supply 27.3% of respondents confirmed that their household domestic water supply was the public piped water supply. Just over thirty-six percent (36.4%) stated the private tank as the main domestic water supply. Approximately fourteen percent (13.6%) stated private water truck while 22.7% stated the spring/river as the main source of domestic water.

As it pertained to respondents’ having any problems with the domestic water supply, 59.1% of those interviewed indicated that there were problems with the water supply while 40.9% indicated that there were no problems with the domestic water supply. For those persons who confirmed that there were problems with the domestic water supply, no one (0.0%) indicated that there was no water at all, 7.7% stated that no pipes were run in the area and 100.0% indicated that the water supply was irregular. Responses exceeded 100% as some individuals indicated that there were multiple problems being experienced with their water supply.

In response to how persons coped with problems related to domestic/household water supply, of those confirming that there were problems with supply (59.1%), no respondent (0.0%) indicated that they stored water, 38.5% indicated that they harvested/collected rain water while 76.9% stated that they bought water, and 7.7% stated that water was supplied by the water truck. Responses exceeded 100.0% as some individuals indicated that they addressed the problems in multiple ways.

On the issue of access to a residential (fixed line/landline) telephone 86.4% of interviewees indicated that they did not have access to a residential telephone while 16.1% confirmed that they had access.

Of the 86.4% of persons indicating that they did not have a fixed line at their residence 100.0% of these individuals indicated that they owned a mobile phone. Additionally, 5.3% of these individuals indicated that they knew of someone who had a fixed-line service.

Regarding the main method of garbage disposal for households, 54.5% of those interviewed indicated that the public garbage truck was the main garbage disposal method while the remaining 45.5% indicated that burning was the main method used to dispose of garbage. No one interviewed stated “private collection” as the main method of garbage disposal for households.

Regarding the frequency of collections of the 54.5% of respondents who indicated that the garbage truck was the main method of garbage disposal, 8.3% indicated that garbage collections were done once per week and 91.7% stated once per month.

When asked about flooding all persons (100.0%) interviewed offered a response and further stated that flooding did not affect their community.

Regarding whether there were problems with frequent flooding at or near the proposed site, 18.2% of interviewees, stated that the area was not affected by flooding, while 81.8% stated that they did not know if the area was affected, while no one (0.0%) stated that the area was affected by flooding.

On the issue of whether the proposed area was affected by tidal changes such as sea level rise or storm surge 100.0% of interviewees offered a response. Approximately ninety-six percent (95.5%) of respondents stated that they did not know if the area was affected while 4.5% stated that the area was not affected by tidal changes and 0.0% indicated that the area was affected by tidal changes.

As it pertained to whether the proposed area was affected by beach erosion in the past 100.0% of interviewees offered a response. Approximately ninety-six percent (95.5%) of respondents stated that they did not know if the area was affected while 4.5% stated that the area was not affected by beach erosion in the past and 0.0% indicated that the area was affected.

Regarding whether there was any site nearby considered to be a protected area, historic area or area of national, historic or environmental importance, 95.5% of interviewees stated they did not know of any such area or site, 4.5% stated that no such area was located near to the proposed area while no one (0.0%) indicated that there was an area/site which was considered to be a protected area or area of historic, national or environmental importance.

7.1.2.9 Pell River and Friendship

Approximately four percent (6.7%) of respondents were from the Pell River (2.3%) and Friendship (1.7%) communities. Approximately sixty-seven percent (66.7%) of respondents were male and 33.3% were female.

Age cohort distribution was as follows; 8.3% were 18-25 years of age, 16.7% were 26-33 years, 16.7% were age 34-41 years, 33.3% were age 42-50 years, 16.7% were age 51-60 years and 8.3% were older than sixty years of age.

Of those persons interviewed who offered a response (100.0%), 41.7% indicated that they were self-employed, while 58.3% stated that they had an employer. No one (0.0%) stated they were unemployed and similarly no one (5.0%) stated they were retired. Additionally, 83.3% of interviewees when asked confirmed that they were the head of their household while 16.7% indicated that they were not the household head.

Regarding the number of persons residing in households, 16.7% of households had one occupant, 16.7% had two occupants while 41.6% had three occupants and 16.7% also had four persons living in the household. No one interviewed (0.0%) indicated that there were five persons living in the household and 8.3% of households had more than five persons residing.

In general, interviewees resided in their communities over the long term. Just under forty-two percent (41.8%) of individuals resided in their communities for all their life, and 25.0% resided in their community in excess of fifteen years. Approximately eight percent (8.3%) stated they lived in their community for between ten and fifteen years. A similar percentage, 8.3%, resided in their community for between five and ten years, three and five years and under two years respectively.

On the issue of where healthcare was mostly obtained, no one (0.0%) stated the public clinic, 58.3% stated the public hospital and 50.0% stated that healthcare needs were mostly sourced through the private doctor. No one interviewed (0.0%) stated the private hospital. It should be noted that in some instances, respondents offered multiple responses regarding where they mainly went for healthcare, therefore percentages exceeded one hundred.

As it related to whether respondents suffered from specific medical conditions, 16.7% of interviewees indicated that they were asthmatic and 16.7% also indicated that they suffered from sinusitis. No one interviewed (0.0%) confirmed coughing as an ailment, indicated that they suffered from congestion/bronchial problems or indicated that they suffered from chest pains or confirmed frequent bouts of diarrhoea. Approximately sixty-seven (66.6%) percent of those interviewed indicated that they did not suffer from any of the specific conditions named.

Of those interviewed, fifty percent (50.0%) of respondents refused to offer a response relating to their personal weekly income. None of the persons interviewed (0.0%) indicated that they did not have a weekly income, while 8.4% indicated that their weekly income was under the previous national minimum wage of $6,200.00 per week. No interviewee (0.0%) indicated that their weekly income was $6,200.00 per week; 8.3% stated that their weekly income was between $6,201.00-$10,000.00, while 25.0% stated a weekly income ranging between $10,001.00 and $20,000.00. Just over eight percent (8.3%) indicated that their weekly income was in excess of twenty thousand dollars ($20,000.00).

Regarding the highest level of education completed, all persons interviewed (100.0%) offered a response. Of this number no one (0.0%) indicated that they did not attend school; 8.3% stated they completed primary/all age school, 25.0% stated that they did not complete high school and 66.7% completed high school. No one interviewed (0.0%) completed college, university or HEART/Vocational Training Institution.

As it pertained to education, 75.0% of interviewees indicated someone in the household was attending school. As it related to the school being attended 11.1% stated that the school being attended was infant/basic, 22.2% stated primary/all age, 66.7% stated high school, 0.0% college 0.0% university and 11.1% HEART/Vocational Training Institute. It should be noted that percentages will exceed one hundred as multiple persons from households attend school.

When respondents were asked about the presence of recreational spaces in their community 83.3% of those offering a response indicated that a recreational space was present. Recreational spaces named were:

- Pell River Community Centre/Ball Field (90.0%)
- Friendship Greenspace (10.0%)

On the issue of respondents' awareness of Princess Hotels and Resorts, all (100.0%) interviewees offered a response. Just over eight percent (8.3%) of interviewees stated that they had heard of the hotel, while 91.7% stated that they had not heard of Princess Hotels and Resorts.

Regarding respondents' awareness of proposed hotel construction, all (100%) respondents offered a response. Of these individuals, approximately eight percent (8.3%) of individuals stated that they had heard of the proposed project while 91.7% stated that they had never heard of the project. Of the 8.3% of respondents who heard of the project, 100.0% indicated word of mouth as medium by which they were made aware.

Regarding what was specifically known/heard about the proposed project, 100.0% stated that they were aware that the hotel was to be built.

As it regarded respondents' awareness of the development of a wastewater treatment plant, all interviewees (100.0%) offered a response and stated that they were not aware of this project component.

As it regarded respondents' awareness of the proposed drainage system, all interviewees (100.0%) offered a response and further stated that they were not aware of this project component.

As it pertained to respondents' awareness of the whether there have been problems/issues in the Industry Bay area, all (100.0%) respondents offered a response. Of these individuals, no one (0.0%) stated that there have been problems/issues in the Industry Bay area while 41.7% stated that there have never been any problems/issues in the area. Approximately fifty-eight percent (58.3%) of respondents stated that they were not aware of any problems/issues in the area.

Regarding whether respondents had any concerns about the project, 100.0% of interviewees offered responses. Of these persons, 16.7% indicated that they had concerns about the project while 75.0% stated that they did not have any concern while 8.3% of respondents indicated that they were not sure if they had any concerns, as they needed more information. Concerns expressed pertained to:

- Wastewater disposal (50.0%)
- Job opportunity (especially for local community) (50.0%)

On the issue of whether respondents depended on the proposed location for any business or activity, all (100.0%) interviewees offered a response and further stated that they did not use the area for any type of business or activity.

As it pertained to respondents' knowing anyone who depended on the proposed area for any type of business or activity, all persons (100.0%) offered a response. Just over percent (8.3%) of respondents confirmed that they knew someone who depended on the proposed project area for some type of business of activity, while 91.7% of individuals indicated that they did not know of anyone who depended on the area. Of those who confirmed that they know of someone who depended on the proposed area (8.3%), it was stated that they depended on the area for:

- Fishing (to include vending) (100.0%)

Regarding respondents' opinions on how they anticipated the project to affect their lives, 100.0% of interviewees offered a response. Of these individuals, 33.3% of respondents indicated that the project would not affect their life in any way, while 50.0% anticipated a positive impact and no one (0.0%) anticipated a negative impact. Just under seventeen percent (16.7%) were not sure if the project would affect their life.

Regarding the 50.0% of individuals anticipating a positive impact, they anticipated:

- Job opportunities would be created (100.0%)

On the issue of how interviewees thought the project would affect the marine life, 100.0% of those interviewed offered a response. Of these, 25.0% indicated that they were unsure about how the marine life would be affected while 58.3% indicated that the marine life would not be affected. No one (0.0%) indicated that the marine life would be positively affected while 16.7% indicated that the project would negatively impact the marine life.

For those anticipating a negative impact on the marine life (16.7%), it was expressed that the construction project would result in:

- Loss of marine life (flora and fauna) (50.0%)
- Sewage discharge into the ocean (50.0%)

On the issue of how interviewees thought the project would affect the general environment, 91.7% of those interviewed offered a response. Of these, 27.3% indicated that they were unsure about how the general environment would be affected while 72.7% indicated that the general environment would not be affected. No one interviewed (0.0%) indicated that the general environment would be positively affected similarly no one indicated that the project would negatively impact the general environment.

Regarding how interviewees thought the project would impact flooding in nearby areas, 100.0% of those interviewed offered a response. Of these, 33.3% indicated that they were unsure about how flooding may be impacted while 58.4% indicated that the project would not impact flooding. No one (0.0%) indicated that there would be a positive impact while 8.3% indicated that the project would negatively impact flooding in nearby areas.

For those anticipating a negative impact on flooding in nearby areas (8.3%), all respondents (100.0%) expressed that the new infrastructure would result in (cause) flooding.

As it related to housing 100.0% of interviewees offered responses. Approximately sixty-seven percent (66.7%) of respondents stated that they owned the house they lived in, 8.3% lived in rented homes, while 25.0% stated that they lived in family owned homes.

As it pertained to the land on which dwelling homes were located 100.0% of interviewees offered responses. Approximately thirty-three percent (33.3%) of respondents stated that they owned the land on which the house is located, 8.3% stated that the land was leased, no one (0.0%) had their homes on government owned lands, 8.3% indicated that they squatted on the land, while 41.8% stated that their homes were built on family land, while 8.3% stated “other” and indicated that the home they lived in was rented but there was no arrangement made with respect to the land.

Regarding the type of wall that dwellings were made of 58.3% of interviewees indicated that the walls of their homes were made of concrete and blocks while 75.0% stated wood/board. It should be noted that percentages exceeded 100.0% as some respondents indicated that the walls of their homes were made of both concrete and blocks and wood/board materials. This was mainly due to structural additions to increase habitable living space.

Regarding the type of roof that dwellings had, 91.7% of respondents indicated that the roof of their homes was metal sheeting, while 33.3% stated concrete. Percentages exceeded 100.0% as roofs were made of multiple materials, in most instances metal sheeting and concrete. This was due to structural additions to increase habitable living space.

As it pertained to the type of toilet facility present, 83.3% of respondents indicated that their homes had water closets, while 16.7% stated that pit latrine was the toilet facility.

As it related to what the household used for lighting, 91.7% of interviewees stated that electricity was used while 8.3% stated kerosene oil was used.

Regarding the type of fuel used mostly for cooking, all (100.0%) of persons interviewed indicated that gas was used mostly.

On the issue of the main source of household domestic water supply 75.0% of respondents confirmed that their household domestic water supply was the public piped water supply. Just over eight percent (8.3%) indicated that the public standpipe was the main source of domestic water supply for the household while 8.4% stated that household water was supplied by government water truck and 0.0% stated private water truck while 8.3% stated the spring/river as the main source of domestic water.

As it pertained to respondents' having any problems with the domestic water supply, 41.7% of those interviewed indicated that there were problems with the water supply while 58.3% indicated that there were no problems with the domestic water supply. For those persons who confirmed that there were problems with the domestic water supply, 20.0% indicated that there was no water at all, 80.0% indicated that the water supply was irregular and 20.0% of respondents stated "other" and indicated that at times when the NWC "turns off" the water supply, it is not promptly restored and telephone calls have to be made to request service restoration.

In response to how persons coped with problems related to domestic/household water supply, of those confirming that there were problems with supply (47.1%), twenty percent (20.0%) of respondents indicated that they stored water, no one (0.0%) indicated that they harvested/collected rain water, 20.0% stated that they bought water, 20.0% also stated that they collected water from a spring or river while 20.0% stated that they used the community standpipe. Some respondents (20.0%) did not indicate how they coped with problems associated with the domestic water supply.

On the issue of access to a residential (fixed line/landline) telephone 100.0% of interviewees indicated that they did not have access to a residential telephone. Of these persons indicating that they did not have a fixed line at their residence 917% of these individuals indicated that they owned a mobile phone. Additionally, 33.3% of these individuals indicated that they knew of someone who had a fixed-line service.

Regarding the main method of garbage disposal for households, 83.3% of those interviewed indicated that the public garbage truck was the main garbage disposal method while the remaining 16.7% indicated that burning was the main method used to dispose of garbage. No one interviewed stated "private collection" as the main method of garbage disposal for households.

Regarding the frequency of collections of the 83.3% of respondents who indicated that the garbage truck was the main method of garbage disposal, 30.0% indicated that garbage collections were done once per week, 40.0% stated every two weeks, and 30.0% stated once per month.

When asked about flooding all persons (100.0%) interviewed offered a response and further stated that flooding did not affect their community.

Regarding whether there were problems with frequent flooding at or near the proposed site, 66.7% of interviewees, stated that the area was not affected by flooding, while 33.3% stated that they did not know if the area was affected; no one (0.0%) stated that the area was affected by flooding.

On the issue of whether the proposed area was affected by tidal changes such as sea level rise or storm surge 100.0% of interviewees offered a response. Approximately Fifty-eight percent (58.3%) of respondents stated that they did not know if the area was affected while 41.7% stated that the area was not affected by tidal changes. No one interviewed (0.0%) indicated that the area was affected by tidal changes.

As it pertained to whether the proposed area was affected by beach erosion in the past 100.0% of interviewees offered a response. Approximately Fifty-eight percent (58.3%) of respondents stated that they did not know if the area was affected while 41.7% stated that the area was not affected by beach erosion in the past. No one interviewed (0.0%) indicated that the area was affected.

Regarding whether there was any site nearby considered to be a protected area, historic area or area of national, historic or environmental importance, 58.3% of interviewees stated they did not know of any such area or site, 41.7% stated that no such area was located near to the proposed area while no one (0.0%) indicated that there was an area/site which was considered to be a protected area or area of historic, national or environmental importance.

7.1.2.10 Grange and Saxham

Eight percent (8.0%) of respondents were from the Grange (5.7%) and Saxham (2.3%) communities. Approximately sixty-seven percent (66.7%) of respondents were male and 33.3% were female.

Age cohort distribution was as follows; 16.7% were 18-25 years of age, 41.7% were 26-33 years, 16.7% were age 34-41 years, 16.7% were age 42-50 years, 4.2% were age 51-60 years and 4.2% were older than sixty years of age.

Of those persons interviewed who offered a response (100.0%), 50.0% indicated that they were self-employed, while 41.7% stated that they had an employer and 8.3% stated they were unemployed. None (0.0%) of the individuals interviewed were retired. Additionally, 58.3% of interviewees when asked confirmed that they were the head of their household while 41.7% indicated that they were not the household head.

Regarding the number of persons residing in households, approximately thirteen percent (12.5%) of households had one occupant while 25.0% had two occupants, 16.7% had three occupants while 8.3% had four persons living in the household. Just over eight percent (8.3%) also had five persons living in the household and 29.2% of households had more than five persons residing.

In general, interviewees resided in their communities over the long term. Approximately forty-two percent (41.6%) of individuals resided in their communities for all their life, and 33.3% resided in their community in excess of fifteen years. Approximately four percent (4.2%) stated they lived in their community for between ten and fifteen years; 16.7% resided for between five and ten years. Just over four percent (4.2%) resided in their community for between three and five years. No one (0.0%) resided in their community for under two years.

On the issue of where healthcare was mostly obtained, 4.2% stated the public clinic, 66.7% stated the public hospital and 37.5% stated that healthcare needs were mostly sourced through the private doctor. No one interviewed (0.0%) stated the private hospital. It should be noted that in some instances, respondents offered multiple responses regarding where they mainly went for healthcare, therefore percentages exceeded one hundred.

As it related to whether respondents suffered from specific medical conditions, 20.8% of interviewees indicated that they were asthmatic, 33.3% indicated that they suffered from sinusitis, 4.2% confirmed coughing as an ailment, while 8.3% indicated that they suffered from congestion/bronchial problems. Just over three percent (8.3%) indicated that they suffered from chest pains while none (0.0%) of those interviewed confirmed frequent bouts of diarrhoea. Approximately thirty-three (33.3%) percent of those interviewed indicated that they did not suffer from any of the specific conditions named. It should be noted that in some instances, respondents suffered from more than one of the listed ailments, therefore percentages exceeded one hundred.

Of those interviewed, just over thirty-three percent (33.3%) of respondents refused to offer a response relating to their personal weekly income. Approximately eight percent (8.3%) of persons indicated that they did not have a weekly income, while no one (0.0%) indicated that their weekly income was under the previous national minimum wage of $6,200.00 per week. Just over four percent (4.2%) of interviewees indicated that their weekly income was $6,200.00 per week; 25.0% stated that their weekly income was between $6,201.00-$10,000.00, while 16.7% stated a weekly income ranging between $10,001.00 and $20,000.00. Approximately thirteen percent (12.5%) indicated that their weekly income was in excess of twenty thousand dollars ($20,000.00).

Regarding the highest level of education completed, all persons interviewed (100.0%) offered a response, additionally no one interviewed (0.0%) indicated that they did not attend school. Just under seventeen percent (16.6%) stated they completed primary/all age school, 20.8% stated that they did not complete high school, 54.2% completed high school, 4.2% college, 0.0% university and 4.2% HEART/Vocational Training Institution.

As it pertained to education, 62.5% of interviewees indicated someone in the household was attending school. As it related to the school being attended 33.3% stated that the school being attended was infant/basic, 46.7% stated primary/all age, 40.0% stated high school and 6.7% college. No one interviewed (0.0%) stated university or HEART/Vocational Training Institute. It should be noted that percentages will exceed one hundred as multiple persons from households attend school.

When respondents were asked about the presence of recreational spaces in their community 70.8% of those offering a response indicated that a recreational space was present. Recreational spaces named were:

- Cauldwell Community Centre (5.9%) (now occupied by the military since the SOE)
- Grange Greenspace (94.1%)

On the issue of respondents' awareness of Princess Hotels and Resorts, all (100.0%) interviewees offered a response. Just under seventeen percent (16.7%) of interviewees stated that they had heard of the hotel, while 83.3% stated that they had not heard of Princess Hotels and Resorts.

Regarding respondents' awareness of proposed hotel construction, all (100%) respondents offered a response. Of these individuals, 45.8% of individuals stated that they had heard of the proposed project while 54.2% stated that they had never heard of the project. Of the 45.8% of respondents who heard of the project, 9.1% indicated radio, while 90.9% indicated word of mouth as the medium by which they were made aware.

Regarding what was specifically known/heard about the proposed project, 100.0% stated that they were aware that the hotel was to be built.

As it regarded respondents' awareness of the development of a wastewater treatment plant, all interviewees (100.0%) offered a response and further stated that they were not aware of this project component.

As it regarded respondents' awareness of the proposed drainage system, all interviewees (100.0%) offered a response and further stated that they were not aware of this project component.

As it pertained to respondents' awareness of the whether there have been problems/issues in the Industry Bay area, all (100.0%) respondents offered a response. Of these individuals, no one interviewed (0.0%) stated that there have been problems/issues in the Industry Bay area while 75.0% stated that there have never been any problems/issues in the area. Twenty-five percent (25.0%) of respondents stated that they were not aware of any problems/issues in the area.

Regarding whether respondents had any concerns about the project, 100.0% of interviewees offered responses. Of these persons, 37.5% indicated that they had concerns about the project while 54.2% stated that they did not have any concern while 8.3% of respondents indicated that they were not sure if they had any concerns, as they needed more information. Concerns expressed pertained to:

- The project resulting in further road damage (11.1%)
- Increases solid waste (11.1%)
- Wastewater disposal (11.1%)
- Job opportunity (especially for local community) (33.3%)
- Increased risk of flooding (22.2%)
- Whether the community will benefit from drainage upgrades and sewage infrastructure (11.1%)
- When the project would commence (11.1%)

It should be noted that percentages exceeded 100.0% as some respondents expressed multiple concerns.

On the issue of whether respondents depended on the proposed location for any business or activity, all (100.0%) interviewees offered a response. Approximately eight percent (8.3%) of respondents indicated that they used the proposed location for some type of business or activity while 91.7% stated that they did not use the area for any type of business or activity. Of those who confirmed that they depended on the proposed area (8.3%), individuals stated that they depended on the area for:

- Fishing (50.0%)
- Recreation (50.0%)
- To purchase fish (50.0%)

It should be noted that percentages exceeded 100.0% as some respondents indicated dependence on the area for multiple activities.

As it pertained to respondents' knowing anyone who depended on the proposed area for any type of business or activity, all persons (100.0%) offered a response. Approximately thirteen percent (12.5%) of respondents confirmed that they knew someone who depended on the proposed project area for some type of business of activity, while 87.5% of individuals indicated that they did not know of anyone who depended on the area. Of those who confirmed that they know of someone who depended on the proposed area (12.5%), it was stated that they depended on the area for:

- Fishing (to include vending) (100.0%)

Regarding respondents' opinions on how they anticipated the project to affect their lives, 100.0% of interviewees offered a response. Of these individuals, 16.7% of respondents indicated that the project would not affect their life in any way, while 75.0% anticipated a positive impact and no one (0.0%) anticipated a negative impact. Just over eight percent (8.3%) were not sure if the project would affect their life.

Regarding the 75.0% of individuals anticipating a positive impact, they anticipated:

- Job opportunities would be created (94.4%)
- Improved infrastructure (5.6%)

On the issue of how interviewees thought the project would affect the marine life, 100.0% of those interviewed offered a response. Of these, 37.5% indicated that they were unsure about how the marine life would be affected while 54.2% indicated that the marine life would not be affected. No one (0.0%) indicated that the marine life would be positively affected while 8.3% indicated that the project would negatively impact the marine life.

For those anticipating a negative impact on the marine life (8.3%), it was expressed that the construction project would result in:

- Loss of marine life (flora and fauna) (50.0%)
- Sewage discharge into the ocean (50.0%)

On the issue of how interviewees thought the project would affect the general environment, 100.0% of those interviewed offered a response. Of these, 25.0% indicated that they were unsure about how the general environment would be affected while 66.6% indicated that the general environment would not be affected. Just over four percent (4.2%) indicated that the general environment would be positively affected while 4.2% also indicated that the project would negatively impact the general environment.

Of those expecting a positive impact on the general environment (4.2%), all (100.0%) stated that they anticipated community development as a positive impact

For those anticipating a negative impact on the general environment (4.2%), it was expressed that the project would result in:

- Damage to the environment (100.0%)
- Increased air pollution (100.0%)

It should be noted that percentages exceeded 100.0% as some respondents offered multiple responses.

Regarding how interviewees thought the project would impact flooding in nearby areas, 100.0% of those interviewed offered a response. Of these, 16.7% indicated that they were unsure about how flooding may be impacted while 70.8% indicated that the project would not impact flooding. Just over four percent (4.2%) indicated that there would be a positive impact while 8.3% indicated that the project would negatively impact flooding in nearby areas.

Of those expecting a positive impact on flooding in nearby areas (4.2%), all respondents (100.0%) stated that the project would reduce the risk of flooding in nearby areas.

For those anticipating a negative impact on flooding in nearby areas (4.2%), 50.0% expressed that the new infrastructure would result in (cause) flooding. Some respondents (50.0%) offered no response.

As it related to housing 100.0% of interviewees offered responses. Approximately forty-six percent (45.8%) of respondents stated that they owned the house they lived in, no one (0.0%) stated that their residence was leased, 4.2% lived in rented homes, no one (0.0%) indicated that they squatted in their homes, while 48.5% stated that they lived in family owned homes. No one interviewed lived in government owned housing, while 42% stated “other” and further advised that they were caretakers overseeing the homes they lived in.

As it pertained to the land on which dwelling homes were located 100.0% of interviewees offered responses. Approximately four percent (4.2%) of respondents stated that they owned the land on which the house is located, 25.0% stated that the land was leased, no one (0.0%) had their homes on government owned lands, 4.2% indicated that they squatted on the land, while 54.1% stated that their homes were built on family land, while 12.5% stated “other” and indicated that the home they lived in was rented but there was no arrangement made with respect to the land while some persons indicated that they were caretakers.

Regarding the type of wall that dwellings were made of 50.0% of interviewees indicated that the walls of their homes were made of concrete and blocks while 70.8% stated wood/board. It should be noted that percentages exceeded 100.0% as some respondents indicated that the walls of their homes were made of both concrete and blocks and wood/board materials. This was mainly due to structural additions to increase habitable living space.

Regarding the type of roof that dwellings had, 87.5% of respondents indicated that the roof of their homes was metal sheeting, while 16.7% stated concrete. Percentages exceeded 100.0% as roofs were made of multiple materials, in most instances metal sheeting and concrete. This was due to structural additions to increase habitable living space.

As it pertained to the type of toilet facility present, 58.3% of respondents indicated that their homes had water closets, while 37.5% stated that pit latrine was the toilet facility and 4.2% indicated that their homes did not have a toilet facility.

As it related to what the household used for lighting, 100.0% of interviewees stated that electricity was used for household lighting.

Regarding the type of fuel used mostly for cooking, 100.0% of persons interviewed indicated that gas was used mostly.

On the issue of the main source of household domestic water supply 75.0% of respondents confirmed that their household domestic water supply was the public piped water supply. Just over four percent (4.2%) stated the private tank as the main domestic water supply while 8.3% indicated that the public standpipe was the main source of domestic water supply for the household. Approximately thirteen percent (12.5%) stated that household water was supplied by private water truck.

As it pertained to respondents' having any problems with the domestic water supply, 54.2% of those interviewed indicated that there were problems with the water supply while 45.8% indicated that there were no problems with the domestic water supply. For those persons who confirmed that there were problems with the domestic water supply, 23.1% indicated that there was no water at all, 46.2% indicated that the water supply was irregular while 23.1% stated that water pressure was low and 7.6% of respondents stated "other" and indicated that they did not apply for a connection.

In response to how persons coped with problems related to domestic/household water supply, of those confirming that there were problems with supply (54.2%), just over fifteen percent (15.4%) indicated that they harvested/collected rain water, 38.5% stated that they bought water, 23.1% stated that they collected water from a spring or river while 46.2% stated that they used the community standpipe and 7.7% stated that water was supplied by the water truck. Responses exceeded 100% as some individuals indicated that they addressed the problems in multiple ways.

On the issue of access to a residential (fixed line/landline) telephone 95.8% of interviewees indicated that they did not have access to a residential telephone while 4.2% confirmed that they had access. Of the 95.8% of persons indicating that they did not have a fixed line at their residence 100.0% of these individuals indicated that they owned a mobile phone. Additionally, 21.7% of these individuals indicated that they knew of someone who had a fixed-line service.

Regarding the main method of garbage disposal for households, 100.0% of those interviewed indicated that the public garbage truck was the main garbage disposal method for households.

Regarding the frequency of collections, of the respondents who indicated that the garbage truck was the main method of garbage disposal, 41.7% indicated that garbage collections were done once per week, 8.3% stated twice per week, 16.7% stated every two weeks, 25.0% stated once per month and 8.3% stated less than once per month.

When asked about flooding all persons (100.0%) interviewed offered a response. Twenty-five percent (25.0%) of respondents indicated that their community was affected by flooding while 75.0% stated that flooding did not affect their community. Those indicating that their community was affected stated that flooding occurred only during times of heavy rain (83.3%) and each time there was a rainfall event. These respondents also indicated that rain events causing flooding occurred:

- Once weekly (16.6%)
- Once monthly (16.7%)
- Once every three months (50.0%)
- Less than once per year (16.7%)

Affected areas named were:

- Grange Square

Regarding the height to which water levels rose 100.0% of those confirming that flooding occurred offered a response. Of these respondents, 20.0% stated that water levels were less than 0.3 metre, 60.0% stated that during times of flooding water levels rose to between 0.3 and 1.5 metres while 20.0% advised that water levels exceeded 1.5 metres.

Regarding whether there were problems with frequent flooding at or near the proposed site, 62.5% of interviewees, stated that the area was not affected by flooding, while 25.0% stated that they did not know if the area was affected, while 12.5% stated that the area was affected by flooding. Of the 12.5% of those stating that there were flooding problems, 100.0% stated only in times of heavy rains. These respondents also indicated that rain events causing flooding occurred:

- Once monthly (33.3%)
- Once every three months (66.7%)

Specific areas named were:

- Harding Hall

Regarding the height to which water levels rose, 100.0% of those indicating that at or nearby the proposed area was affected by flooding offered a response and further stated that water levels rose to between 0.3 and 1.5 metres.

On the issue of whether the proposed area was affected by tidal changes such as sea level rise or storm surge 100.0% of interviewees offered a response. Approximately Fifty-four percent (54.2%) of respondents stated that they did not know if the area was affected while 45.8% stated that the area was not affected by tidal changes and no one interviewed (0.0%) indicated that the area was affected by tidal changes.

As it pertained to whether the proposed area was affected by beach erosion in the past 100.0% of interviewees offered a response. Fifty percent (50.0%) of respondents stated that they did not know if the area was affected while 45.8% stated that the area was not affected by beach erosion in the past and 4.2% indicated that the area was affected.

Regarding whether there was any site nearby considered to be a protected area, historic area or area of national, historic or environmental importance, 37.5% of interviewees stated they did not know of any such area or site, 62.5% stated that no such area was located near to the proposed area while no one (0.0%) indicated that there was an area/site which was considered to be a protected area or area of historic, national or environmental importance.

7.1.2.11 Prospect

Approximately five percent (4.7%) of respondents were from the Prospect community. Fifty percent (50.0%) of respondents were male and 50.0% were female.

Age cohort distribution was as follows; 21.4% were 18-25 years of age, 14.3% were 26-33 years, 35.7% were age 34-41 years, 14.3% were age 42-50 years and 14.3% were age 51-60 years. No one interviewed (0.0%) was older than sixty years of age.

Of those persons interviewed who offered a response (100.0%), 50.0% indicated that they were self-employed, while 35.7% stated that they had an employer and 14.3% stated they were unemployed. No one interviewed (0.0%) stated that they were retired. Additionally, 71.4% of interviewees when asked confirmed that they were the head of their household while 28.6% indicated that they were not the household head.

Regarding the number of persons residing in households, just over seven percent (7.1%) of households had one occupant while 21.5% had two occupants, 28.6% had three occupants while 7.1% had four persons living in the household. Approximately twenty-nine percent (28.6%) had five persons living in the household and 7.1% of households had more than five persons residing.

In general, interviewees resided in their communities over the long term. Fifty percent (50.0%) of individuals resided in their communities for all their life, and 21.4% resided in their community in excess of fifteen years. No one interviewed (0.0%) stated they lived in their community for between ten and fifteen years and similarly no one (0.0%) resided for between five and ten years. Just over fourteen percent (14.3%) resided in their community for between three and five years and 14.3% for under two years.

On the issue of where healthcare was mostly obtained, 14.3% stated the public clinic, 50.0% stated the public hospital and similarly 50.0% stated that healthcare needs were mostly sourced through the private doctor. No one interviewed (0.0%) stated the private hospital. It should be noted that in some instances, respondents offered multiple responses regarding where they mainly went for healthcare, therefore percentages exceeded one hundred.

As it related to whether respondents suffered from specific medical conditions, 14.3% of interviewees indicated that they were asthmatic, while 21.4% indicated that they suffered from sinusitis, No one (0.0%) confirmed coughing as an ailment, neither did they state that they suffered from congestion/bronchial problems, chest pains or frequent bouts of diarrhoea. Approximately sixty-four (64.3%) percent of those interviewed indicated that they did not suffer from any of the specific conditions named.

Of those interviewed, just over percent (14.3%) of respondents refused to offer a response relating to their personal weekly income. Approximately seven percent (7.1%) of persons indicated that they did not have a weekly income, while no one (0.0%) indicated that their weekly income was under the previous national minimum wage of $6,200.00 per week. Approximately seven percent (7.1%) of interviewees indicated that their weekly income was $6,200.00 per week; 21.4% stated that their weekly income was between $6,201.00-$10,000.00, while 35.8% stated a weekly income ranging between $10,001.00 and $20,000.00. Just over fourteen percent (14.3%) indicated that their weekly income was in excess of twenty thousand dollars ($20,000.00).

Regarding the highest level of education completed, all persons interviewed (100.0%) offered a response. Of this number no one (0.0%) indicated that they did not attend school; 7.1% stated they completed primary/all age school, 64.4% completed high school, 0.0% college, 7.1% university and 21.4% HEART/Vocational Training Institution.

As it pertained to education, 57.1% of interviewees indicated someone in the household was attending school. As it related to the school being attended 37.5% stated that the school being attended was infant/basic, 75.0% stated primary/all age, 12.5% stated high school, 0.0% college 0.0% university and 12.5% HEART/Vocational Training Institute. It should be noted that percentages will exceed one hundred as multiple persons from households attend school.

When respondents were asked about the presence of recreational spaces in their community 50.0% of those offering a response indicated that a recreational space was present. Recreational spaces named were:

- Green Island High School Field (14.3%)

- Cauldwell Community Centre (14.3%) (now occupied by the military since the SOE)
- Pell River Community Centre/Ball Field (14.3%)
- Friendship Greenspace (28.6%)
- Grange Greenspace (14.3%)
- Prospect Greenspace (14.2%)

On the issue of respondents' awareness of Princess Hotels and Resorts, all (100.0%) interviewees offered a response. Just over seven percent (7.1%) of interviewees stated that they had heard of the hotel, while 92.9% stated that they had not heard of Princess Hotels and Resorts.

Regarding respondents' awareness of proposed hotel construction, all (100%) respondents offered a response. Of these individuals, approximately twenty-nine percent (28.6%) of individuals stated that they had heard of the proposed project while 71.4% stated that they had never heard of the project. Of the 28.6% of respondents who heard of the project, all individuals (100.0%) indicated word of mouth as the medium by which they were made aware.

Regarding what was specifically known/heard about the proposed project, 100.0% stated that they were aware that the hotel was to be built.

As it regarded respondents' awareness of the development of a wastewater treatment plant, all interviewees (100.0%) offered a response and further stated that they were not aware of this project component.

As it regarded respondents' awareness of the proposed drainage system, all interviewees (100.0%) offered a response and further stated that they were not aware of this project component.

As it pertained to respondents' awareness of the whether there have been problems/issues in the Industry Bay area, all (100.0%) respondents offered a response. Of these individuals, no one interviewed (0.0%) stated that there have been problems/issues in the Industry Bay area while 85.7% stated that there have never been any problems/issues in the area. Just over fourteen percent (14.3%) of respondents stated that they were not aware of any problems/issues in the area.

Regarding whether respondents had any concerns about the project, 100.0% of interviewees offered responses. Of these persons, 14.3% indicated that they had concerns about the project while 85.7% stated that they did not have any concern. Concerns expressed pertained to:

- Job opportunity (especially for local community) (50.0%)
- Pollution (noise/water/air) (50.0%)

On the issue of whether respondents depended on the proposed location for any business or activity, all (100.0%) interviewees offered a response and further stated that they did not use the area for any type of business or activity.

As it pertained to respondents' knowing anyone who depended on the proposed area for any type of business or activity, all persons (100.0%) offered a response. Just over twenty-one percent (21.4%) of respondents confirmed that they knew someone who depended on the proposed project area for some type of business of activity, while 78.6% of individuals indicated that they did not know of anyone who depended on the area. Of those who confirmed that they know of someone who depended on the proposed area (21.4%), it was stated that they depended on the area for:

- Fishing (to include vending) (100.0%)
- Recreation (33.3%)

It should be noted that percentages exceeded 100.0% as some respondents indicated dependence on the area for multiple activities.

Regarding respondents' opinions on how they anticipated the project to affect their lives, 100.0% of interviewees offered a response. Of these individuals, 28.6% of respondents indicated that the project would not affect their life in any way, while 57.2% anticipated a positive impact and 7.1% anticipated a negative impact. Just over seven percent (7.1%) were not sure if the project would affect their life.

Regarding the 57.1% of individuals anticipating a positive impact, they anticipated:

- Job opportunities would be created (87.5%)
- Economic Growth (25.0%)

Percentages exceeded 100.0% as respondents offered multiple responses.

As it pertained to the 7.1% of interviewees who indicated that they thought the project would affect their lives negatively, they anticipated:

- Pollution (to include, noise air and water) (100.0%)

On the issue of how interviewees thought the project would affect the marine life, 100.0% of those interviewed offered a response. Of these, 7.1% indicated that they were unsure about how the marine life would be affected while 92.9% indicated that the marine life would not be affected. No one (0.0%) indicated that the marine life would be positively affected and similarly no one indicated that the project would negatively impact the marine life.

On the issue of how interviewees thought the project would affect the general environment, 100.0% of those interviewed offered a response and further indicated that the general environment would not be affected.

Regarding how interviewees thought the project would impact flooding in nearby areas, 100% of those interviewed offered a response. Of these, 14.3% indicated that they were unsure about how flooding may be impacted while 85.5% indicated that the project would not impact flooding. No one (0.0%) indicated that there would be a positive impact and similarly no one indicated that the project would negatively impact flooding in nearby areas.

As it related to housing 100.0% of interviewees offered responses. Approximately fifty-seven percent (57.2%) of respondents stated that they owned the house they lived in, 21.4% lived in rented homes, while 21.4% also stated that they lived in family owned homes. No one interviewed lived in leased, rented or government owned housing.

As it pertained to the land on which dwelling homes were located 100.0% of interviewees offered responses. Approximately twenty-nine percent (28.6%) of respondents stated that they owned the land on which the house is located, no one (0.0%) stated that the land was leased and similarly no one (0.0%) had their homes on government owned lands. Just over seven percent (7.1%) indicated that they squatted on the land, while 42.9% stated that their homes were built on family land, while 21.4% stated "other" and indicated that the home they lived in was rented but there was no arrangement made with respect to the land.

Regarding the type of wall that dwellings were made of 42.9% of interviewees indicated that the walls of their homes were made of concrete and blocks while 71.4% stated wood/board. It should be noted that percentages exceeded 100.0% as some respondents indicated that the walls of their homes were made of both concrete and blocks and wood/board materials. This was mainly due to structural additions to increase habitable living space.

Regarding the type of roof that dwellings had, 71.4% of respondents indicated that the roof of their homes was metal sheeting, while 42.9% stated concrete. Percentages exceeded 100.0% as roofs were made of multiple materials, in most instances metal sheeting and concrete. This was due to structural additions to increase habitable living space.

As it pertained to the type of toilet facility present, 100.0% of respondents indicated that their homes had water closets.

As it related to what the household used for lighting, 100.0% of interviewees stated that electricity was used for household lighting.

Regarding the type of fuel used mostly for cooking, 100.0% of persons interviewed indicated that gas was used mostly.

On the issue of the main source of household domestic water supply 85.8% of respondents confirmed that their household domestic water supply was the public piped water supply. Approximately seven percent (7.1%) stated the private tank as the main domestic water supply and 7.1% also stated private water truck. No one interviewed (0.0%) stated the community tank, the public standpipe, the government water truck while or the spring/river as the main source of domestic water.

As it pertained to respondents' having any problems with the domestic water supply, 21.4% of those interviewed indicated that there were problems with the water supply while 78.6% indicated that there were no problems with the domestic water supply. For those persons who confirmed that there were problems with the domestic water supply, 33.3% indicated that there was no water at all, 33.3% indicated that the water supply was irregular while 66.7% stated that water pressure was low. Responses exceeded 100% as some individuals indicated that there were multiple problems being experienced with their water supply.

In response to how persons coped with problems related to domestic/household water supply, of those confirming that there were problems with supply (21.4%), all respondents (100.0%) indicated that they bought water and 33.3% stated that they used the community standpipe. Responses exceeded 100% as some individuals indicated that they addressed the problems in multiple ways.

On the issue of access to a residential (fixed line/landline) telephone 69.2% of interviewees indicated that they did not have access to a residential telephone while 30.8% confirmed that they had access. Of the 69.2% of persons indicating that they did not have a fixed line at their residence 100.0% of these individuals indicated that they owned a mobile phone. Additionally, 44.4% of these individuals indicated that they knew of someone who had a fixed-line service.

Regarding the main method of garbage disposal for households, 92.9% of those interviewed indicated that the public garbage truck was the main garbage disposal method while the remaining 7.1% indicated that burning was the main method used to dispose of garbage.

Regarding the frequency of collections of the 92.9% of respondents who indicated that the garbage truck was the main method of garbage disposal, 15.4% indicated that garbage collections were done once per week, 30.8% stated twice per week, 23.0% stated every two weeks and 30.8% stated once per month.

When asked about flooding all persons (100.0%) interviewed offered a response and further stated that flooding did not affect their community.

Regarding whether there were problems with frequent flooding at or near the proposed site, 71.4% of interviewees, stated that the area was not affected by flooding, while 28.6% stated that they did not know if the area was affected. No one (0.0%) stated that the area was affected by flooding.

On the issue of whether the proposed area was affected by tidal changes such as sea level rise or storm surge 100.0% of interviewees offered a response. Fifty percent (50.0%) of respondents stated that they did not know if the area was affected while 50.0% also stated that the area was not affected by tidal changes. No one (0.0%) indicated that the area was affected.

As it pertained to whether the proposed area was affected by beach erosion in the past 100.0% of interviewees offered a response. Approximately Fifty-seven percent (78.6%) of respondents stated that they did not know if the area was affected while 21.4% stated that the area was not affected by beach erosion in the past. No one (0.0%) indicated that the area was affected.

Regarding whether there was any site nearby considered to be a protected area, historic area or area of national, historic or environmental importance, 57.1% of interviewees stated they did not know of any such area or site, 42.9% stated that no such area was located near to the proposed area while no one (0.0%) indicated that there was an area/site which was considered to be a protected area or area of historic, national or environmental importance.

7.1.2.12 Harding Hall

Approximately four percent (3.7%) of respondents were from the Harding Hall community. Approximately forty-six percent (45.5%) of respondents were male and 54.5% were female.

Age cohort distribution was as follows; 18.2% were 18-25 years of age, 36.4% were 26-33 years, 18.2% were age 34-41 years, 18.2% were age 42-50 years, 9.0% were age 51-60 years. No one interviewed (0.0%) was older than sixty years of age.

Of those persons interviewed who offered a response (100.0%), 18.2% indicated that they were self-employed, while 54.5% stated that they had an employer and 27.3% stated they were unemployed. No one interviewed (0.0%) was retired. Additionally, 63.6% of interviewees when asked confirmed that they were the head of their household while 36.4% indicated that they were not the household head.

Regarding the number of persons residing in households, approximately eighteen percent (18.2%) of households had one occupant while 36.4% had two occupants, 27.2% had three occupants while 9.1% had four persons living in the household. Just over nine percent (9.1%) had five persons living in the household while no (0.0%) household had more than five persons residing.

As it pertained to how long persons resided in their community, 18.2% of individuals resided in their communities for all their life, 9.1% resided in their community in excess of fifteen years and 18.2% stated they lived in their community for between ten and fifteen years. Just over twenty-seven percent (27.2%) resided in their community for between five and ten years while just over eighteen percent (18.2%) resided in their community for between three and five years and 9.1% for under two years.

On the issue of where healthcare was mostly obtained, 9.0% stated the public clinic, 45.5% stated the public hospital and similarly 45.5% stated that healthcare needs were mostly sourced through the private doctor. No one interviewed (0.0%) stated the private hospital.

As it related to whether respondents suffered from specific medical conditions, 36.4% of interviewees indicated that they were asthmatic, 9.1% indicated that they suffered from sinusitis, 9.1% confirmed coughing as an ailment, while no one (0.0%) indicated that they suffered from congestion/bronchial problems. Just over nine percent (9.1%) indicated that they suffered from chest pains while none (0.0%) of those interviewed confirmed frequent bouts of diarrhoea. Approximately thirty-six (36.3%) percent of those interviewed indicated that they did not suffer from any of the specific conditions named.

Of those interviewed, just over twenty-seven percent (27.3%) of respondents refused to offer a response relating to their personal weekly income and a similar 27.3% of persons indicated that they did not have a weekly income. No one (0.0%) indicated that their weekly income was under the previous national minimum wage of $6,200.00 per week and no one (0.0%) indicated that their weekly income was $6,200.00 per week. Approximately nine percent (9.1) % stated that their weekly income was between $6,201.00-$10,000.00, while 36.4% stated a weekly income ranging between $10,001.00 and $20,000.00. No one (0.0%) indicated that their weekly income was in excess of twenty thousand dollars ($20,000.00).

Regarding the highest level of education completed, all persons interviewed (100.0%) offered a response. Of this number no one (0.0%) indicated that they did not attend school, did not complete high school, completed college or completed university. Just over eighteen percent (18.2%) stated they completed primary/all age school, 54.5% completed high school, and 27.3% HEART/Vocational Training Institution.

As it pertained to education, 45.5% of interviewees indicated someone in the household was attending school. As it related to the school being attended 40.0% stated that the school being attended was infant/basic, 60.0% stated primary/all age while 40.0% stated high school. No one interviewed (0.0%) stated that the school being attended was college, university or HEART/Vocational Training Institute. It should be noted that percentages will exceed one hundred as multiple persons from households attend school.

When respondents were asked about the presence of recreational spaces in their community 100.0% of those offering a response indicated that no recreational space was present in their community.

On the issue of respondents' awareness of Princess Hotels and Resorts, all (100.0%) interviewees offered a response. Just over fifty-four percent (54.5%) of interviewees stated that they had heard of the hotel, while 45.5% stated that they had not heard of Princess Hotels and Resorts.

Regarding respondents' awareness of proposed hotel construction, all (100%) respondents offered a response. Of these individuals, approximately sixty-four percent (63.6%) of individuals stated that they had heard of the proposed project while 36.4% stated that they had never heard of the project. Of the 63.6% of respondents who heard of the project, all individuals (100.0%) indicated word of mouth as the medium by which they were made aware.

Regarding what was specifically known/heard about the proposed project, 85.7% stated that they were aware that the hotel was to be built. Some respondents (14.3%) while indicating awareness did not offer specific information.

As it regarded respondents' awareness of the development of a wastewater treatment plant, all interviewees (100.0%) offered a response. Approximately nine percent (9.1%) of interviewees stated that they were aware of the proposed wastewater treatment plant construction while 90.9% stated that they were not aware of this project component. Regarding what was specifically heard, none of the respondents (0.0%) indicating awareness offered specific information.

Of the 9.1% of respondents who heard of the wastewater treatment plant project, all individuals (100.0%) indicated word of mouth as the medium by which they were made aware.

As it regarded respondents' awareness of the proposed drainage system, all interviewees (100.0%) offered a response. Approximately twenty-seven percent (27.3%) of interviewees stated that they were aware of the proposed drainage upgrade while 72.7% stated that they were not aware of this project component. Regarding what was specifically heard, none of the respondents (0.0%) indicating awareness offered specific information.

Of the 27.3% of respondents who heard of the drainage system upgrade, 66.7% indicated word of mouth as the medium by which they were made aware. It should be noted that 33.3% of respondents while indicating awareness did not specify the medium by which they were made aware.

As it pertained to respondents' awareness of the whether there have been problems/issues in the Industry Bay area, all (100.0%) respondents offered a response. Of these individuals, no one (0.0%) stated that there have been problems/issues in the Industry Bay area while 72.7% stated that there have never been any problems/issues in the area. Approximately twenty-seven percent (27.3%) of respondents stated that they were not aware of any problems/issues in the area.

Regarding whether respondents had any concerns about the project, 100.0% of interviewees offered responses. Of these persons, 27.3% indicated that they had concerns about the project while 72.7% stated that they did not have any concern. Concerns expressed pertained to:

- Job opportunity (especially for local community) (66.7%)
- The project attracting criminal elements during construction phase (33.3%)

On the issue of whether respondents depended on the proposed location for any business or activity, all (100.0%) interviewees offered a response. Just over Twenty-seven percent (27.3%) of respondents indicated that they used the proposed location for some type of business or activity while 72.7% stated that they did not use the area for any type of business or activity. Of those who confirmed that they depended on the proposed area (27.3%), individuals stated that they depended on the area for:

- To purchase fish (100.0%)

As it pertained to respondents' knowing anyone who depended on the proposed area for any type of business or activity, all persons (100.0%) offered a response. Just under eighty-two percent (81.8%) of respondents confirmed that they knew someone who depended on the proposed project area for some type of business of activity, while 18.2% of individuals indicated that they did not know of anyone who depended on the area. Of those who confirmed that they know of someone who depended on the proposed area (81.8%), it was stated that they depended on the area for:

- Fishing (to include vending) (100.0%)

Regarding respondents' opinions on how they anticipated the project to affect their lives, 100.0% of interviewees offered a response. Of these individuals, 27.3% of respondents indicated that the project would not affect their life in any way, while 72.7% anticipated a positive impact and no one (0.0%) anticipated a negative impact.

Regarding the 72.7% of individuals anticipating a positive impact, they anticipated:

- Job opportunities would be created (100.0%)

On the issue of how interviewees thought the project would affect the marine life, 100.0% of those interviewed offered a response. Of these, 36.3% indicated that they were unsure about how the marine life would be affected while 18.2% indicated that the marine life would not be affected. No one (0.0%) indicated that the marine life would be positively affected while 45.5% indicated that the project would negatively impact the marine life.

For those anticipating a negative impact on the marine life (45.5%), it was expressed that the construction project would result in:

- Fish migration (80.0%)
- Improper solid waste disposal (specifically into the ocean) (20.0%)

On the issue of how interviewees thought the project would affect the general environment, 100.0% of those interviewed offered a response. Of these, 36.4% indicated that they were unsure about how the general environment would be affected while 27.3% indicated that the general environment would not be affected. Just over twenty-seven percent (27.3%) indicated that the general environment would be positively affected while 9.0% indicated that the project would negatively impact the general environment.

Of those expecting a positive impact on the general environment (27.3%), all individuals (100.0%) stated that they anticipated community development as a positive impact.

For those anticipating a negative impact on the general environment (9.0%), it was expressed that the project would result in:

- Increased air pollution (100.0%)

Regarding how interviewees thought the project would impact flooding in nearby areas, 100.0% of those interviewed offered a response. Of these, 9.1% indicated that they were unsure about how flooding may be impacted while 90.9% indicated that the project would not impact flooding. No one (0.0%) indicated that there would be a positive impact, similarly 0.0% indicated that the project would negatively impact flooding in nearby areas.

As it related to housing 100.0% of interviewees offered responses. Approximately sixty-four percent (63.6%) of respondents stated that they owned the house they lived in, 9.1% stated that their residence was leased, 9.1% lived in rented homes, no one (0.0%) indicated that they squatted in their homes, while 18.2% stated that they lived in family owned homes. No one interviewed lived in government owned housing.

As it pertained to the land on which dwelling homes were located 100.0% of interviewees offered responses. Approximately nine percent (9.1%) of respondents stated that they owned the land on which the house is located, 54.5% stated that the land was leased, no one (0.0%) had their homes on government owned lands, 27.3% indicated that they squatted on the land, while 9.1% stated that their homes were built on family land.

Regarding the type of wall that dwellings were made of 18.2% of interviewees indicated that the walls of their homes were made of concrete and blocks while 81.8% stated wood/board.

Regarding the type of roof that dwellings had, all respondents (100.0%) indicated that the roof of their homes was metal sheeting.

As it pertained to the type of toilet facility present, 81.8% of respondents indicated that their homes had water closets, while 18.2% stated that pit latrine was the toilet facility.

As it related to what the household used for lighting, 100.0% of interviewees stated that electricity was used for household lighting.

Regarding the type of fuel used mostly for cooking, 90.9% of persons interviewed indicated that gas was used mostly and 9.1% stated electricity as the main cooking fuel.

On the issue of the main source of household domestic water supply 63.6% of respondents confirmed that their household domestic water supply was the public piped water supply. Just over twenty-seven percent (27.3%) stated the private tank as the main domestic water supply and 9.1% stated private water truck. No one interviewed (0.0%) stated the community tank, the public standpipe, the government water truck while or the spring/river as the main source of domestic water.

As it pertained to respondents' having any problems with the domestic water supply, 9.1% of those interviewed indicated that there were problems with the water supply while 90.9% indicated that there were no problems with the domestic water supply. For those persons who confirmed that there were problems with the domestic water supply, 100.0% indicated that the water supply was irregular.

In response to how persons coped with problems related to domestic/household water supply, of those confirming that there were problems with supply (9.1%), all Individuals (100.0%) stated that they bought water.

On the issue of access to a residential (fixed line/landline) telephone 72.7% of interviewees indicated that they did not have access to a residential telephone while 23.3% confirmed that they had access. Of the 72.7% of persons indicating that they did not have a fixed line at their residence 100.0% of these individuals indicated that they owned a mobile phone. Additionally, 62.5% of these individuals indicated that they knew of someone who had a fixed-line service.

Regarding the main method of garbage disposal for households, 81.8% of those interviewed indicated that the public garbage truck was the main garbage disposal method while the remaining 18.2% indicated that burning was the main method used to dispose of garbage.

Regarding the frequency of collections of the 81.8% of respondents who indicated that the garbage truck was the main method of garbage disposal, 66.7% indicated that garbage collections were done once per week, 22.2% stated every two weeks and 11.1% stated once per month.

When asked about flooding all persons (100.0%) interviewed offered a response. Just over nine percent (9.1%) of respondents indicated that their community was affected by flooding while 90.9% stated that flooding did not affect their community. Those indicating that their community was affected stated that flooding occurred only during times of heavy rain (100.0%). These respondents also indicated that rain events causing flooding occurred:

- Once monthly (100.0%)

No affected areas were named.

Regarding the height to which water levels rose all (100.0%) of those confirming that flooding occurred offered a response and further stated that during times of flooding water levels rose to between 0.3 and 1.5 metres.

Regarding whether there were problems with frequent flooding at or near the proposed site, 90.9% of interviewees, stated that the area was not affected by flooding, while 9.1% stated that they did not know if the area was affected. No one (0.0%) stated that the area was affected by flooding.

On the issue of whether the proposed area was affected by tidal changes such as sea level rise or storm surge 100.0% of interviewees offered a response. Approximately sixty-four percent (63.6%) of respondents stated that they did not know if the area was affected while 18.2% stated that the area was not affected by tidal changes and 18.2% also indicated that the area was affected by tidal changes.

As it pertained to whether the proposed area was affected by beach erosion in the past 100.0% of interviewees offered a response. Approximately eighty-two percent (81.8%) of respondents stated that they did not know if the area was affected while 18.2% stated that the area was not affected by beach erosion in the past. No one (0.0%) indicated that the area was affected.

Regarding whether there was any site nearby considered to be a protected area, historic area or area of national, historic or environmental importance, 9.1% of interviewees stated they did not know of any such area or site, 90.0% stated that no such area was located near to the proposed area. No one interviewed (0.0%) indicated that there was an area/site which was considered to be a protected area or area of historic, national or environmental importance.

7.1.2.13 Haughton Hall, Abingdon/Haughton and Rhodes Hall

Approximately four percent (3.6%) of respondents were from the Haughton Hall (0.7%). Abingdon/Haughton (1.2%) and Rhodes Hall (1.7%) communities. Approximately sixty-four percent (63.6%) of respondents were male and 36.4% were female.

Age cohort distribution was as follows; no one interviewed (0.0%) was 18-25 years of age, 18.2% were 26-33 years, 27.2% were age 34-41 years, 9.1% were age 42-50 years, 36.4% were age 51-60 years and 9.1% were older than sixty years of age.

Of those persons interviewed who offered a response (100.0%), 27.3% indicated that they were self-employed, while 63.6% stated that they had an employer and 9.1% stated they were unemployed. None (0.0%) of the individuals interviewed was retired. Additionally, 90.9% of interviewees when asked confirmed that they were the head of their household while 9.1% indicated that they were not the household head.

Regarding the number of persons residing in households, 36.4% of households had one occupant while 18.2% had two occupants, 9.0% had three occupants while 18.2% had four persons living in the household. No household (0.0%) had five persons living in the household while 18.2% of households had more than five persons residing.

In general, interviewees resided in their communities over the long term. Approximately forty-six percent (45.5%) of individuals resided in their communities for all their life, and 27.3% resided in their community in excess of fifteen years. Nine percent (9.0%) stated they lived in their community for between ten and fifteen years. No one interviewed (0.0%) resided for between five and ten years, similarly no one interviewed (0.0%) resided in their community for between three and five years. Just over eighteen percent (18.2%) resided in the community for under two years.

On the issue of where healthcare was mostly obtained, 27.3% stated the public clinic, 45.5% stated the public hospital and similarly 45.5% stated that healthcare needs were mostly sourced through the private doctor. No one interviewed (0.0%) stated the private hospital. It should be noted that in some instances, respondents offered multiple responses regarding where they mainly went for healthcare, therefore percentages exceeded one hundred.

As it related to whether respondents suffered from specific medical conditions, 18.2% of interviewees indicated that they were asthmatic, 9.1% indicated that they suffered from sinusitis. No one (0.0%) confirmed coughing as an ailment, neither did they state that they suffered from congestion/bronchial problems, chest pains or frequent bouts of diarrhoea. Approximately seventy-three (72.7%) percent of those interviewed indicated that they did not suffer from any of the specific conditions named.

Of those interviewed, just over forty-five percent (45.5%) of respondents refused to offer a response relating to their personal weekly income. No one interviewed (0.0%) of persons indicated that they did not have a weekly income, similarly no one (0.0%) indicated that their weekly income was under the previous national minimum wage of $6,200.00 per week. Approximately eighteen percent (18.2%) of interviewees indicated that their weekly income was $6,200.00 per week; 9.1% stated that their weekly income was between $6,201.00-$10,000.00, while 18.2% stated a weekly income ranging between $10,001.00 and $20,000.00. Just over nine percent (9.1%) indicated that their weekly income was in excess of twenty thousand dollars ($20,000.00).

Regarding the highest level of education completed, all persons interviewed (100.0%) offered a response. Of this number no one (0.0%) indicated that they did not attend school, did not complete high school, completed college, completed university or completed HEART/Vocational Training Institution. Approximately thirty-six percent (36.4%) stated they completed primary/all age school while 63.6% completed high school

As it pertained to education, 45.5% of interviewees indicated someone in the household was attending school. As it related to the school being attended 20.0% stated that the school being attended was infant/basic, 80.0% stated primary/all age, 40.0% stated high school, 20.0% college, 0.0% university and 0.0% HEART/Vocational Training Institute. It should be noted that percentages will exceed one hundred as multiple persons from households attend school.

When respondents were asked about the presence of recreational spaces in their community 63.6% of those offering a response indicated that a recreational space was present. Recreational spaces named were:

- Green Island High School Field (14.3%)
- Green Island Community Centre (28.6%)
- Logwood Community Centre/Ball Field (14.3%)
- Rhodes Hall Greenspace (14.3%)
- Orange Bay Playing Field (28.5%)

On the issue of respondents' awareness of Princess Hotels and Resorts, all (100.0%) interviewees offered a response. Just over twenty-seven percent (27.3%) of interviewees stated that they had heard of the hotel, while 72.7% stated that they had not heard of Princess Hotels and Resorts.

Regarding respondents' awareness of proposed hotel construction, all (100%) respondents offered a response. Of these individuals, approximately forty-six percent (45.5%) of individuals stated that they had heard of the proposed project while 54.5% stated that they had never heard of the project. Of the 45.5% of respondents who heard of the project, 20.0% stated television, 20.0% indicated radio, 20.0% of interviewees stated they were made aware via community meeting and 60.0% indicated word of mouth as the medium by which they were made aware. It should be noted that respondents offered multiple responses therefore percentages exceeded one hundred.

Regarding what was specifically known/heard about the proposed project, 100.0% stated that they were aware that the hotel was to be built.

As it regarded respondents' awareness of the development of a wastewater treatment plant, all interviewees (100.0%) offered a response and further stated that they were not aware of this project component.

As it regarded respondents' awareness of the proposed drainage system, all interviewees (100.0%) offered a response and further stated that they were not aware of this project component.

As it pertained to respondents' awareness of the whether there have been problems/issues in the Industry Bay area, all (100.0%) respondents offered a response. Of these individuals, no one interviewed (0.0%) stated that there have been problems/issues in the Industry Bay area while 72.7% stated that there have never been any problems/issues in the area. Approximately twenty-seven percent (27.3%) of respondents stated that they were not aware of any problems/issues in the area.

Regarding whether respondents had any concerns about the project, 100.0% of interviewees offered responses and further stated that they did not have any concern

On the issue of whether respondents depended on the proposed location for any business or activity, all (100.0%) interviewees offered a response and indicated that they did not use the area for any type of business or activity.

As it pertained to respondents' knowing anyone who depended on the proposed area for any type of business or activity, all persons (100.0%) offered a response. Approximately eighteen percent (18.2%) of respondents confirmed that they knew someone who depended on the proposed project area for some type of business of activity, while 81.8% of individuals indicated that they did not know of anyone who depended on the area. Of those who confirmed that they know of someone who depended on the proposed area (18.2%), it was stated that they depended on the area for:

- Fishing (to include vending) (100.0%)

Regarding respondents' opinions on how they anticipated the project to affect their lives, 100.0% of interviewees offered a response. Of these individuals, 18.2% of respondents indicated that the project would not affect their life in any way, while 54.5% anticipated a positive impact. No one (0.0%) anticipated a negative impact. Just over twenty-seven percent (27.3%) were not sure if the project would affect their life.

Regarding the 54.5% of individuals anticipating a positive impact, they anticipated:

- Job opportunities would be created (83.3%)
- Community Development (16.7%)

On the issue of how interviewees thought the project would affect the marine life, 100.0% of those interviewed offered a response. Of these, 54.5% indicated that they were unsure about how the marine life would be affected while 45.5% indicated that the marine life would not be affected. No one (0.0%) indicated that the marine life would be positively affected and similarly no one (0.0%) indicated that the project would negatively impact the marine life.

On the issue of how interviewees thought the project would affect the general environment, 100.0% of those interviewed offered a response. Of these, 45.5% indicated that they were unsure about how the general environment would be affected and 45.5% also indicated that the general environment would not be affected. No one (0.0%) indicated that the general environment would be positively affected while 9.0% indicated that the project would negatively impact the general environment.

For those anticipating a negative impact on the general environment (9.0%), it was expressed that the project would result in:

- Damage to the environment (100.0%)

Regarding how interviewees thought the project would impact flooding in nearby areas, 100.0% of those interviewed offered a response. Of these, 45.5% indicated that they were unsure about how flooding may be impacted while 54.5% indicated that the project would not impact flooding. No one (0.0%) indicated that there would be a positive impact and similarly no one (0.0%) indicated that the project would negatively impact flooding in nearby areas.

As it related to housing 100.0% of interviewees offered responses. Approximately sixty-four percent (63.6%) of respondents stated that they owned the house they lived in, 9.1% lived in rented homes, while 27.3% stated that they lived in family owned homes. No one interviewed (0.0%) lived in leased or government owned housing, nor indicated that they squatted in their dwelling.

As it pertained to the land on which dwelling homes were located 100.0% of interviewees offered responses. Nine (9.0%) of respondents stated that they owned the land on which the house is located, 27.3% stated that the land was leased, 18.2% had their homes on government owned lands, no one (0.0%) indicated that they squatted on the land, 36.4% stated that their homes were built on family land, while 9.1% stated "other" and indicated that the home they lived in was rented but there was no arrangement made with respect to the land.

Regarding the type of wall that dwellings were made of27.3% of interviewees indicated that the walls of their homes were made of concrete and blocks while 72.7% stated wood/board.

Regarding the type of roof that dwellings had, 90.9% of respondents indicated that the roof of their homes was metal sheeting, while 9.1% stated concrete.

As it pertained to the type of toilet facility present, 63.6% of respondents indicated that their homes had water closets, while 36.4% stated that pit latrine was the toilet facility.

As it related to what the household used for lighting, 100.0% of interviewees stated that electricity was used for household lighting.

Regarding the type of fuel used mostly for cooking, 90.9% of persons interviewed indicated that gas was used mostly and 9.1% stated electricity as the main cooking fuel.

On the issue of the main source of household domestic water supply 90.9% of respondents confirmed that their household domestic water supply was the public piped water supply. Approximately nine percent (9.1%) indicated that the public standpipe was the main source of domestic water supply for the household. No one interviewed (0.0%) stated the private tank, the community tank, government water truck, private water truck or the spring/river as the main source of domestic water.

As it pertained to respondents' having any problems with the domestic water supply all interviewees (100.0%) offered a response and further stated that they did not any problems with their domestic water supply.

On the issue of access to a residential (fixed line/landline) telephone 100.0% of interviewees indicated that they did not have access to a residential telephone. All respondents (100.0%) further indicated that they owned a mobile phone. Additionally, 18.2% of these individuals indicated that they knew of someone who had a fixed-line service.

Regarding the main method of garbage disposal for households, 90.9% of those interviewed indicated that the public garbage truck was the main garbage disposal method while the remaining 9.1% indicated that burning was the main method used to dispose of garbage.

Regarding the frequency of collections of the 90.9% of respondents who indicated that the garbage truck was the main method of garbage disposal, 60.0% indicated that garbage collections were done once per week, 10.0% stated twice per week, 10.0% stated every two weeks and 20.0% stated once per month.

When asked about flooding all persons (100.0%) interviewed offered a response and stated that flooding did not affect their community.

Regarding whether there were problems with frequent flooding at or near the proposed site, 63.6% of interviewees, stated that the area was not affected by flooding, while 36.4% stated that they did not know if the area was affected. No one (0.0%) stated that the area was affected by flooding.

On the issue of whether the proposed area was affected by tidal changes such as sea level rise or storm surge 100.0% of interviewees offered a response. Approximately twenty-seven percent (27.3%) of respondents stated that they did not know if the area was affected while 72.7% stated that the area was not affected by tidal changes. No one interviewed (0.0%) indicated that the area was affected by tidal changes.

As it pertained to whether the proposed area was affected by beach erosion in the past 100.0% of interviewees offered a response. Approximately Fifty-nine percent (63.6%) of respondents stated that they did not know if the area was affected while 36.4% stated that the area was not affected by beach erosion in the past. No one (0.0%) indicated that the area was affected.

Regarding whether there was any site nearby considered to be a protected area, historic area or area of national, historic or environmental importance, 54.5 of interviewees stated they did not know of any such area or site, 45.5% stated that no such area was located near to the proposed area. No one interviewed (0.0%) indicated that there was an area/site which was considered to be a protected area or area of historic, national or environmental importance.

7.1.2.14 Salt Spring and Hatchwell

Approximately four percent (3.7%) of respondents were from the Salt Spring (2.0%) and Hatchwell (1.7%) communities. Approximately sixty-four percent (63.6%) of respondents were male and 36.4% were female.

Age cohort distribution was as follows; 2732% were 18-25 years of age, 18.2% were 26-33 years, 36.3% were age 34-41 years, 9.1% were age 42-50 years, 9.1% were age 51-60 years and no one (0.0%) was older than sixty years of age.

Of those persons interviewed who offered a response (100.0%), 27.3% indicated that they were self-employed, while 45.5% stated that they had an employer and 18.2% stated they were unemployed. Nine percent (9.0%) of individuals were retired. Additionally, 81.8% of interviewees when asked confirmed that they were the head of their household while 18.2% indicated that they were not the household head.

Regarding the number of persons residing in households, 18.2% of households had one occupant while 36.4% had two occupants, 18.2% had three occupants while 18.2% also had four persons living in the household. No one interviewed (0.0%) had five persons living in the household and 9.0% of households had more than five persons residing.

Just over twenty-seven percent (27.3%) of individuals resided in their communities for all their life, and 9.1% resided in their community in excess of fifteen years. Approximately twenty-seven percent (27.2%) stated they lived in their community for between ten and fifteen years; 18.2% resided for between five and ten years. Just over nine percent (9.1%) resided in their community for between three and five years and similarly 9.1% for under two years.

On the issue of where healthcare was mostly obtained, 9.0% stated the public clinic, 27.3% stated the public hospital and 72.7% stated that healthcare needs were mostly sourced through the private doctor. It should be noted that in some instances, respondents offered multiple responses regarding where they mainly went for healthcare, therefore percentages exceeded one hundred.

As it related to whether respondents suffered from specific medical conditions, 9.1% of interviewees indicated that they were asthmatic and 9.1% also indicated that they suffered from sinusitis. No one (0.0%) confirmed coughing as an ailment, neither did they state that they suffered from congestion/bronchial problems, chest pains or frequent bouts of diarrhoea. Approximately eighty-two (81.8%) percent of those interviewed indicated that they did not suffer from any of the specific conditions named.

Of those interviewed, nine percent (9.0%) of respondents refused to offer a response relating to their personal weekly income. Just over eighteen percent (18.2%) of persons indicated that they did not have a weekly income. No one interviewed (0.0%) indicated that their weekly income was under the previous national minimum wage of $6,200.00 per week and similarly no one (0.0%) indicated that their weekly income was $6,200.00 per week. Approximately eighteen percent (18.2%) stated that their weekly income was between $6,201.00-$10,000.00, while 45.5% stated a weekly income ranging between

$10,001.00 and $20,000.00. Just over nine percent (9.1%) indicated that their weekly income was in excess of twenty thousand dollars ($20,000.00).

Regarding the highest level of education completed, all persons interviewed (100.0%) offered a response. Of this number no one percent (0.0%) indicated that they did not attend school, nor did anyone state primary/all age school as the highest level of education completed. Just over nine percent 9.1% stated that they did not complete high school, 72.7% completed high school, and 11.0% HEART/Vocational Training Institution. No one (0.0%) indicated that they completed college or university.

As it pertained to education, 18.2% of interviewees indicated someone in the household was attending school. As it related to the school being attended 50.0% stated that the school being attended was infant/basic and 100.0$ stated primary/all age. No household (0.0%) had persons attending high school, college university or HEART/Vocational Training Institute. It should be noted that percentages will exceed one hundred as multiple persons from households attend school.

When respondents were asked about the presence of recreational spaces in their community 54.5% of those offering a response indicated that a recreational space was present. Recreational spaces named were:

- Green Island Community Centre (16.7%)
- Salt Spring Greenspace (83.3%)

On the issue of respondents' awareness of Princess Hotels and Resorts, all (100.0%) interviewees offered a response. Just over nine percent (9.1) of interviewees stated that they had heard of the hotel, while 90.9% stated that they had not heard of Princess Hotels and Resorts.

Regarding respondents' awareness of proposed hotel construction, all (100%) respondents offered a response. Of these individuals, approximately nine percent (9.1%) of individuals stated that they had heard of the proposed project while 90.9% stated that they had never heard of the project. Of the 9.1% of respondents who heard of the project, all respondents (100.0%) indicated word of mouth as the medium by which they were made aware.

Regarding what was specifically known/heard about the proposed project, all respondents (100.0%0 while indicating awareness did not offer specific information.

As it regarded respondents' awareness of the development of a wastewater treatment plant, all interviewees (100.0%) offered a response and stated that they were not aware of this project component.

As it regarded respondents' awareness of the proposed drainage system, all interviewees (100.0%) offered a response and stated that they were not aware of this project component.

As it pertained to respondents' awareness of the whether there have been problems/issues in the Industry Bay area, all (100.0%) respondents offered a response. No one interviewed (0.0%) stated that there have been problems/issues in the Industry Bay area while 36.4% stated that there have never been any problems/issues in the area. Approximately sixty-four percent (63.6%) of respondents stated that they were not aware of any problems/issues in the area.

Regarding whether respondents had any concerns about the project, 100.0% of interviewees offered responses. Of these persons, 9.1% indicated that they had concerns about the project while 63.6% stated that they did not have any concern while 27.3% of respondents indicated that they were not sure if they had any concerns, as they needed more information. Concerns expressed pertained to:

- Job opportunity (especially for local community) (100.0%)

On the issue of whether respondents depended on the proposed location for any business or activity, all (100.0%) interviewees offered a response. Approximately nine percent (9.1%) of respondents indicated that they used the proposed location for some type of business or activity while 90.9% stated that they did not use the area for any type of business or activity. Of those who confirmed that they depended on the proposed area (9.1%), individuals stated that they depended on the area for:

- Fishing (100.0%)

As it pertained to respondents' knowing anyone who depended on the proposed area for any type of business or activity, all persons (100.0%) offered a response. Approximately eighteen percent (18.2%) of respondents confirmed that they knew someone who depended on the proposed project area for some type of business of activity, while 81.8% of individuals indicated that they did not know of anyone who depended on the area. Of those who confirmed that they know of someone who depended on the proposed area (18.2%), it was stated that they depended on the area for:

- Fishing (to include vending) (100.0%)

Regarding respondents' opinions on how they anticipated the project to affect their lives, 100.0% of interviewees offered a response. Of these individuals, 27.2% of respondents indicated that the project would not affect their life in any way, while 27.3% anticipated a positive impact and no one (0.0%) anticipated a negative impact. Approximately forty-six percent (45.5%) were not sure if the project would affect their life.

Regarding the 27.2% of individuals anticipating a positive impact, they anticipated:

- Job opportunities would be created (66.7%)
- Community Development (33.3%)

On the issue of how interviewees thought the project would affect the marine life, 100.0% of those interviewed offered a response. Of these, 36.4% indicated that they were unsure about how the marine life would be affected while 63.3% indicated that the marine life would not be affected. No one (0.0%) indicated that the marine life would be positively affected and similarly no one (0.0%) indicated that the project would negatively impact the marine life.

On the issue of how interviewees thought the project would affect the general environment, 100.0% of those interviewed offered a response. Of these, 45.5% indicated that they were unsure about how the general environment would be affected while 45.5% indicated that the general environment would not be affected. Nine percent (0.0%) indicated that the general environment would be positively affected while no one (0.0%) indicated that the project would negatively impact the general environment.

Of those expecting a positive impact on the general environment (9.0%), all respondents (100.0%) stated that they anticipated community development as a positive impact.

Regarding how interviewees thought the project would impact flooding in nearby areas, 100.0% of those interviewed offered a response. Of these, 45.5% indicated that they were unsure about how flooding may be impacted while 54.5% indicated that the project would not impact flooding. No one interviewed (0.0%) indicated that there would be a positive impact and similarly 0.0% indicated that the project would negatively impact flooding in nearby areas.

As it related to housing 100.0% of interviewees offered responses. Approximately sixty-four percent (63.6%) of respondents stated that they owned the house they lived in, 18.2% lived in rented homes, while 18.2% stated that they lived in family owned homes. No one interviewed lived in government owned housing, squatted in their homes or stated that their residence was leased.

As it pertained to the land on which dwelling homes were located 100.0% of interviewees offered responses. Nine percent (9.0%) of respondents stated that they owned the land on which the house is located, 18.0% stated that the land was leased, 0.0% had their homes on government owned lands, 27.3% indicated that they squatted on the land, while 27.3% stated that their homes were built on family land, while 18.2% stated “other” and indicated that the home they lived in was rented but there was no arrangement made with respect to the land.

Regarding the type of wall that dwellings were made of 54.5% of interviewees indicated that the walls of their homes were made of concrete and blocks while 45.5% stated wood/board.

Regarding the type of roof that dwellings had, 45.5% of respondents indicated that the roof of their homes was metal sheeting, while 54.5% stated concrete.

As it pertained to the type of toilet facility present, 72.7% of respondents indicated that their homes had water closets, while 27.3% stated that pit latrine was the toilet facility.

As it related to what the household used for lighting, 100.0% of interviewees stated that electricity was used for household lighting.

Regarding the type of fuel used mostly for cooking, 100.0% of persons interviewed indicated that gas was used mostly.

On the issue of the main source of household domestic water supply 72.7% of respondents confirmed that their household domestic water supply was the public piped water supply. Approximately nine percent (9.1%) stated the private tank as the main domestic water supply while 18.2% indicated that the public standpipe. No one interviewed (0.0%) stated the community tank, government water truck, private water truck or the spring/river as the main source of domestic water.

As it pertained to respondents' having any problems with the domestic water supply, all respondents (100.0%) indicated that there were no problems with the domestic water supply.

On the issue of access to a residential (fixed line/landline) telephone 54.5% of interviewees indicated that they did not have access to a residential telephone while 45.5% confirmed that they had access. Of the 54.5% of persons indicating that they did not have a fixed line at their residence 100.0% of these individuals indicated that they owned a mobile phone. Additionally, 33.3% of these individuals indicated that they knew of someone who had a fixed-line service.

Regarding the main method of garbage disposal for households, 90.9% of those interviewed indicated that the public garbage truck was the main garbage disposal method while the remaining 9.1% indicated that burning was the main method used to dispose of garbage.

Regarding the frequency of collections of the 90.9% of respondents who indicated that the garbage truck was the main method of garbage disposal, 60.0% indicated that garbage collections were done once per week and 40.0% stated every two weeks.

When asked about flooding all persons (100.0%) interviewed offered a response and further stated that flooding did not affect their community

Regarding whether there were problems with frequent flooding at or near the proposed site, 36.4% of interviewees, stated that the area was not affected by flooding, while 63.6% stated that they did not know if the area was affected. No one interviewed (0.0%) stated that the area was affected by flooding.

On the issue of whether the proposed area was affected by tidal changes such as sea level rise or storm surge 100.0% of interviewees offered a response. Approximately seventy-three percent (72.7%) of respondents stated that they did not know if the area was affected while 27.3% stated that the area was not affected by tidal changes. No one (0.0%) indicated that the area was affected by tidal changes.

As it pertained to whether the proposed area was affected by beach erosion in the past 100.0% of interviewees offered a response. Approximately eighty-two percent (81.8%) of respondents stated that they did not know if the area was affected while 18.2% stated that the area was not affected by beach erosion in the past. No one (0.0%) indicated that the area was affected.

Regarding whether there was any site nearby considered to be a protected area, historic area or area of national, historic or environmental importance, 45.5% of interviewees stated they did not know of any such area or site, 54.5% stated that no such area was located near to the proposed. No one interviewed (0.0%) indicated that there was an area/site which was considered to be a protected area or area of historic, national or environmental importance.

7.1.3 Fishers

Fishing beaches within the area radius of interest (5km) were targeted and in addition while administering the community questionnaire, where fishers were encountered, they were interviewed as such. Fishing areas targeted were in the Cove, Haughton/Abingdon and Green Island areas.

All respondents (100.0%) were male and all were active fishermen. It should be noted that the fishing areas visited were not typical fishing beaches which had fish vendors separate from fishermen. These areas were instead docking/mooring areas and in general fishers sold their catch directly.

Percentages presented are for the total number of persons offering responses; in instances where respondents did not offer an answer to a question, they were not considered part of the analyses.

7.1.3.1 Results and Findings

Of the twenty-four (24) respondents age cohort distribution was as follows; 12.5% were 18-25 years of age, 8.3% were 26-33 years, 25.0% were age 34-41 years, 12.5% were age 42-50 years, 25.0% were age 51-60 years and 16.7% were older than sixty years of age.

Regarding whether anyone else in the household was a fisher, 37.5% indicated that someone else in their household was also a fisher, while 62.5% stated that no other fisher was a part of their household. Of this 37.5% of respondents, just over thirty- three percent (33.3%) indicated that one more person in their household engaged in fishing activities, 44.5% stated that there were two persons while 11.1% stated three persons and 11.1% similarly stated five persons.

During the field exercise, no individual who would be considered as a “true fish vendor” was encountered. It was instead realised that the fishers interviewed sold their catch directly. Patrons included individuals coming to the beach as well as small business and persons in nearby communities

Of those persons interviewed all respondents (100.0%) offered a response; Just under ninety-two percent (91.8%) indicated they were self-employed while 4.1% had an employer. The remaining 4.1% stated that they were retired.

In response to how long persons were fishers, 26.1% indicated that they were engaged in fishing activities for more than thirty years, 13.0% stated they have been fishers for between twenty-five and thirty years, while 26.1% stated between eighteen and twenty-four years. Approximately nine percent, (8.7%) indicated that they have been fishers for between twelve and seventeen years as well as between six and eleven years while 17.4% indicated that they have been fishers for five years or less.

On the issue of where fish was sold, the following places were named:

- Green Island (37.5%)
- Davis Cove Beach (8.3%)
- Haughton Beach (12.5%)
- Lucea (4.2%)
- Negril (4.2%)

- Abingdon (8.3%)
- Industry Cove (8.3%)
- Cousins Cove (12.5%)

In response to where fishing was done 58.3% stated nearshore/the inner harbour as the fishing area while 58.3% also stated that they fished within one to five miles offshore and 16.7% stated that fishing was done more than five miles offshore. Percentages exceeded one hundred as fishers indicated that they fished in multiple areas.

As it pertained to the names of the areas that fishing was done, the following locations/areas were named:

- Green Island Harbour (45.8%)
- Cousins Cove (20.8%)
- Lucea Bay (4.2%)
- Lances Bay (8.3%)
- Old Harbour Bay (4.2%)
- High Rock/First Edge (4.2%)
- Negro Bay (referred to as Nigga Bay) (8.3%)
- Long Point (4.2%)
- Negril (4.2%)
- Orange Bay (8.3%)
- Davis Cove (4.2%)
- Industry Cove (4.2%)
- Fort (4.2%)
- Half Moon (4.2%)
- Haughton/Abingdon (12.5%)
- “Bank” (8.3%)

Percentages exceeded one hundred as multiple responses were received.

Regarding what fishing method was used, 79.2% of respondents used fishing line, 37.5% used the spear, 29.2% used fishing nets,66.7% utilised fish pots and 4.2% stated “other” and further advised that they used the compressor. From explanations received in the field compressor fishing involves a fisher walking on the seafloor actively fishing while connected to an air source in the fishing vessel.

Regarding the type of vessel used for fishing 100.0% of interviewees offered a response. Of this number 29.2% stated they used a canoe without and engine while 62.5% stated that they used a canoe equipped with an engine and 8.3% stated “other” and further explained that no transportation vessel was used for fishing. Of those whose canoes were equipped with engines, just over ninety-three percent (93.3%) stated that their canoes had one engine, while 6.7% stated that the canoe had five engines. It should be noted however that for those stating five engines, only one engine was used at any one time. Engines were interchanged depending on how far from shore fishing would be done.

As it related to engine size, just under seven percent (6.7%) stated an engine size of 25HP, 60HP and 70HP respectively, while approximately ninety-three percent (93.3%) of respondents stated their engine size was 40HP. Percentages exceeded one hundred as multiple engines were used for a single vessel.

Regarding how many persons work on the fishing vessels, 38.1% stated that one person worked on the vessel, 38.1% stated two persons, 14.2% indicated three persons, while 4.8% respectively indicated four persons and five persons.

In response to whether additional persons sold fish with the interviewees, 95.8% of persons offered a response. Of this number 39.1% stated that other persons sold fish with them while 60.9% stated that no other person sold fish with them. Of this 39.1%, all persons provided further information on the actual number of persons. Just under sixty-seven percent (66.7%) of respondents stated that one other person sold fish with them while 33.3% indicated that there were two additional persons.

As it related to how many times per week fish was sold, 4.2% indicated a frequency of once per week, 4.2% also indicated a frequency of twice per week, 8.3% three times weekly, 4.2% four times each week, 12.5% stated a frequency of five times per week while 62.5% stated that fish was sold more than five times per week.

As it pertained to how many times per week fishers went fishing, 8.3% indicated that they went fishing once weekly, 4.2% stated twice weekly, 12.5% indicated three times per week, 4.2% stated four times, 12.5% stated fives time per week while 58.3% stated that they went fishing more than five times per week.

Regarding the species of fish harvested, fishers harvested multiple species therefore percentages exceeded one hundred. The following information was received. Common names are presented:

- Barracuda (25.0%)
- Snapper (79.25)
- Lionfish (4.2%)
- Parrot (50.0%)
- Moonshine (8.3%)
- Bonita (25.0%)
- Kingfish (8.3%)
- Turbit (4.2%)
- Jack (41.7%)
- Goat fish (20.8%)
- Doctor fish (16.7%)
- Wenchman (8.3%)
- Shad (8.3%)
- Grunt (37.5%
- Butterfish (8.3%)
- Lobster & Squid (4.2%)

Regarding the pound catch of fish per week. Approximately twenty-one percent (20.8%) indicated that they harvested less than ten pounds of fish each week, 33.3% stated between 11 and 200 pounds and 33.3% also stated between 21 and 50 pounds. Just over four percent (4.2%) indicated that their weekly pound catch was between 51lbs – 100lbs while 4.2% also stated over 100 pounds as weekly catch. Some respondents (4.2%) offered no information on their pound catch.

In response to how the pound catch has changed, 100.0% of those interviewed responded. Approximately twenty-nine percent (29.2%) of respondents stated that they did not notice a change while 58.3% stated that the pound catch has decreased and 12.5% stated that there was an increase. Additionally, as it pertained to whether there is a season when the sale or catch of fish is increased all respondents (100.0%) stated that there was a specific time/season. The specific times indicated were October also called “running fish season” (95.8%) and from the Month of May onwards (4.2%).

As it related to respondents' observing changes in the types (species) or size of fish harvested all interviewees (100.0%) offered a response. Twenty-five percent (25.0%) of interviewees stated that they did not notice a change in the species or size of fish harvested, while 12.5% stated that they observed and increase and 62.5% indicated that they observed a decrease.

When asked about possible reasons that led to the observed increases in fish size and/or species respondents stated the following:

- Running Fish Season (100.0%)

When asked about possible reasons that led to the observed decreased in fish size and/or species respondents stated the following:

- Compressor Fishers destroy the reef (20.0%)
- Bad Fishing practices (13.3%)
- Water pollution from recent construction activities (6.7%)
- Fishers catching smaller fish (13.3%)
- Fish Migration (6.7%)
- Theft by other fishers (13.3%)

Some respondents (26.7%) did not offer specific information.

Regarding the average weekly income earned from fish sales, 100.0% of interviewees offered a response. Just under forty-six percent (45.8%) of persons stated that their weekly income from fish sales exceeded $8,000.00, while 33.3% stated income of $6,001.00 - $8,000.00, and 4.2% stated income ranging between $4001-$6000. Just over eight percent (8.3%) respectively stated income of $2,001.00 - $4,000.00 and less than $1,000.00.

Additionally, as it pertained whether respondents noticed any change in the income earned from fish sales, 37.5% of those interviewed stated that they did not notice a change in income from fish sales while 33.3% of persons stated that they observed a decrease in income and 29.2% observed an increase.

Those stating a decrease in income from fish sales, further attributed the decrease in sales to:

- Compressor Fishers destroying the reef (12.5%)
- Decrease in size and number of fish (25.0%)
- Increased cost of fishing equipment and lower earnings (12.5%)
- Reduced fish population (12.5%)

Some individuals (37.5%) offered no response.

Those stating an increase in income from fish sales, further attributed the increase in sales to:

- Running Fish Season (28.6%)
- Increase in the unit cost of fish (42.8%)
- Stable Clientele (28.6%)

On the issue of respondents' awareness of Princess Hotels and Resorts, all (100.0%) interviewees offered a response. Just over thirty-three percent (33.3%) of interviewees stated that they had heard of the hotel, while 66.7% stated that they had not heard of Princess Hotels and Resorts.

Regarding respondents' awareness of proposed hotel construction, all (100%) respondents offered a response. Fifty percent (50.0%) of individuals stated that they had heard of the proposed project and 50.0% also stated that they had never heard of the project. Of the 50.0% of respondents who heard of the project, 8.3% stated television, 16.7% of interviewees stated they were made aware via community meeting and 83.3% indicated word of mouth. Percentages exceeded one hundred as respondents were made aware via multiple media

Regarding what was specifically known/heard the proposed project, 50.0% stated that they were aware that the hotel was to be built and 8.3% stated that they heard persons from the Haughton community would be relocated. Some respondents (41.7%) while indicating awareness did not offer specific information.

As it regarded respondents' awareness of the development of a wastewater treatment plant, all interviewees (100.0%) offered a response and further indicated that they were not aware of this project component.

As it regarded respondents' awareness of the proposed drainage system, all interviewees (100.0%) offered a response. Approximately four percent (4.2%) of interviewees stated that they were aware of the proposed drainage upgrade while 95.8% stated that they were not aware of this project component. Regarding what was specifically heard, all individuals indicating awareness stated that existing drains were to be modified. Additionally, these respondents indicated word of mouth as the medium by which they were made aware.

As it pertained to respondents' awareness of the whether there have been problems/issues in the Industry Bay area, 95.8% respondents offered a response. Of these individuals, 8.7% of individuals stated that there have been problems/issues in the Industry Bay area while 73.9% stated that there have never been any problems/issues in the area. Approximately seventeen percent (17.4%) of respondents stated that they were not aware of any problems/issues in the area.

As it pertained to those interviewees indicating that there have been problems/issues in the Industry Bay area, the following problems/issues were highlighted:

- The area is a swamp (inundated by water) (50.0%)
- Past incidents of flooding (prior to the highway construction) (50.0%)

Regarding whether respondents had any concerns about the project, 100.0% of interviewees offered responses. Of these persons, 29.2% indicated that they had concerns about the project while 62.5% stated that they did not have any concern while 8.3% of respondents indicated that they were not sure if they had any concerns, as they needed more information. Concerns expressed pertained to:

- Blasting may damage the reef (14.3%)
- Leachate from marl fill will affect fish (14.3%)
- Construction activities will affect fish population (14.3%)
- Access to fish in the area (14.3%)
- Impact on marine life (14.3%)
- Potential impact on the environment (14.3%)
- Fish migration (14.3%)
- Wastewater impact on mangroves (14.3%)

It should be noted that percentages exceeded 100.0% as some respondents offered multiple responses.

Regarding respondents' opinions on how they anticipated the project to affect their lives, 95.8% of interviewees offered a response. Of these individuals, 52.5% of respondents indicated that the project would not affect their life in any way, while 30.4% anticipated a positive impact and 4.4% anticipated a negative impact. Thirteen percent (13.0%) were not sure if the project would affect their life.

Regarding the 30.4% of individuals anticipating a positive impact, they anticipated:

- Job opportunities would be created (100.0%)

As it pertained to the 4.4% of interviewees who indicated that they thought the project would affect their lives negatively, they anticipated:

- Decreased fish catch/yield (100.0%)

On the issue of how interviewees thought the project would affect the marine life, 95.8% of those interviewed offered a response. Of these, 13.1% indicated that they were unsure about how the marine life would be affected while 56.5% indicated that the marine life would not be affected. No one interviewed (0.0%) indicated that the marine life would be positively affected while 30.4% indicated that the project would negatively impact the marine life.

For those anticipating a negative impact on the marine life (30.4%), it was expressed that the construction of the hotel would result in:

- Coral reef destruction (42.9%)
- Water pollution (14.3%)
- Improper sewage disposal (28.6%)
- Fish migration (28.6%)

Percentages exceeded 100.0% as respondents offered multiple responses.

On the issue of how interviewees thought the project would affect the general environment, 95.8% of those interviewed offered a response. Of these, 26.1% indicated that they were unsure about how the general environment would be affected while 52.2% indicated that the general environment would not be affected. Just under nine percent (8.7%) indicated that the general would be positively affected while 13.0% indicated that the project would negatively impact the general environment.

Of those expecting a positive impact on the general environment (8.7%), fifty percent (50.0%) stated that they anticipated community development as a positive impact. The remaining 50.0% offered no specific information.

For those anticipating a negative impact on the general environment (13.0%), it was expressed that the project would cause:

- Impact from marl fill and blasting (33.3%)
- Air pollution (specifically dust) (66.7%)

Some respondents (5.6%) offered no response.

Regarding how interviewees thought the project would impact flooding in nearby areas, 95.8% of those interviewed offered a response. Of these, 30.4% indicated that they were unsure about how flooding may be impacted while 60.9% indicated that the project would not impact flooding. No one interviewed (0.0%) indicated that there would be a positive impact while 8.7% indicated that the project would negatively impact flooding in nearby areas.

For those anticipating a negative impact on flooding in nearby areas (8.7%), 50.0% of expressed that the project would result in (cause) flooding and 50% similarly expressed that drainage may be inadequate.

Regarding whether there were problems with frequent flooding at or near the proposed site 97.1% of interviewees responded. Of these, 81.8% of interviewees, stated that the area was not affected by flooding, while 9.1% stated that they did not know if the area was affected, and 9.1% stated that the area was affected by flooding. Of the 9.1% of those stating that there were flooding problems, 50.0% stated flooding occurred each time there was a rainfall event and as it pertained to how often it rained to cause flooding these respondents also indicated that rain events causing flooding occurred:

- Once weekly (50.0%)

The remaining 50.0% offered no response

Specific areas named were:

- The swamp

On the issue of how high-water levels rose, 100.0% of those indicating that at or nearby the proposed area was affected by flooding offered a response. Of this number 50.0% indicated that water levels were less than 0.3 metres while 50.0% stated that water levels rose to between 0.3 and 1.5 metres.

On the issue of whether the proposed area was affected by tidal changes such as sea level rise or storm surge 83.3% of interviewees offered a response. Five percent (5.0%) of respondents stated that they did not know if the area was affected while 75.0% stated that the area was not affected by tidal changes and 20.0% indicated that the area was affected by tidal changes.

As it pertained to whether the proposed area was affected by beach erosion in the past 83.3% of interviewees offered a response. Twenty percent (20.0%) of respondents stated that they did not know if the area was affected while 75.0% stated that the area was not affected by beach erosion in the past and 5.0% indicated that the area was affected.

Regarding whether turtles nest at or near the proposed area 87.5% of interviewees offered a response. Just over thirty-three percent (33.3%) of respondents stated that they did not know if turtles nested at or near the proposed site while 38.1% stated that turtles did not nest at or near the proposed area and 28.6% indicated that turtles nested at or near the proposed site.

Specific areas named as turtle nesting areas were:

- The beach area for the proposed site
- Negro Bay (Nigga Bay)
- Half Moon Bay

Regarding whether there was any area at or nearby the site considered to be a fish sanctuary or nursery area 87.5% of interviewees offered a response. Of these respondents, 19.0% of interviewees stated they did not know of any such area or site, 66.7% stated that no such area was located near to the proposed area while 14.3% indicated that there was an area at or nearby the site considered to be a fish sanctuary or nursery area.

Places named were:

- Negro Bay (Nigga Bay) Fish Sanctuary
- Green Island Harbour
- Double Cay
- Green Cay

7.2 PRESCRIPTIVE RIGHTS

There are two established fishing beaches (Green Island and Cousins Cove) and one public bathing beach (Lances Bay) in proximity of the proposed hotel site. Notwithstanding, person have stated that they have used the property from time to time to temporarily beach boats. The socioeconomic survey has indicated that about 5 fishers use it for this purpose. The community survey also revealed that some persons said they sometimes purchase fish or use the property for recreation.

From the findings of the survey it does not appear that there are any good grounds for prescriptive rights existing at the site.

8.0 IDENTIFICATION AND ASSESSMENT OF POTENTIAL IMPACTS

8.1 IMPACT MATRICES

Impact matrices for the site preparation/construction and operational phases were created (Table 8-2 and Table 8-3), while specific impact matrices related to the overwater searooms are shown in Table 8-4 and Table 8-5. Each impact was assessed based on the following criteria, as indicated within each matrix and are grouped as Physical, Biological and Human/ Social (Ogola, 2007):

- **Direction:** - This describes the nature of the potential impact. It can either be positive, negative or no impact of a particular activity (none).
- **Duration:** Environmental impacts have a temporal dimension and needs to be considered in an EIA. Impacts arising at different phases of the project cycle may need to be considered. See Table 8-1 for ranking technique utilised.
- **Magnitude:** This is defined by the severity of each potential impact and indicates whether the impact is irreversible or reversible and estimated potential rate of recovery. The magnitude of an impact cannot be considered large/high if the impact can be successfully mitigated. See Table 8-1 for ranking technique utilised.
- **Extent:** The spatial extent or the zone of influence of the impact should always be determined. An impact can be site-specific and limited to the project area and also within the locality of the proposed project; a regional impact that may extend beyond the local area; and a national impact affecting resources on a national scale which may also in some cases be trans-boundary (international). See Table 8-1 for ranking technique utilised.

It should be noted that the following were also taken into consideration during impact analysis:

- The Consultants' experience,
- Documented impacts from similar projects,
- The data collected,
- Analysis of the processes in the proposed project,
- Information generated from models,
- Concerns raised from stakeholders in the social surveys; and
- Discussions held among the EIA Study team.

Table 8-1 Ranking criteria utilised for duration, magnitude and extent of each potential impact

DURATION	**None (N)** – No temporal effect	**Short (S)** - Impacts lasting 0 – 10 years before recovery occurs. Impact does not persist after the activity ends.	**Medium (M)** - Impacts lasting 10 - 20 years before signs of recovery. Impacts on biological populations are not inter-generational.	**Long (L)** - Impacts are persistent and lasting over 20 years. Impacts on biological populations are over several recruitment cycles or generations of those populations.
MAGNITUDE	**None (N)** - No measurable change in availability of resources or function of systems. No measurable effect on people.	**Small (S)** - Changes in form and/or ecosystem function and/or a resource. The system maintains the ability to support ecosystem/ resource functions with only minor changes in community value and no overall loss/gain and is reversible. Only a small fraction of the local community is affected.	**Medium (M)** - Changes in form and/or ecosystem function and/or a resource. The system's ability to support ecosystem/ resource functions and economic benefit is affected but not lost and is reversible. Only a moderate fraction of the local community is affected.	**Large (L)** - Changes in form and/or ecosystem function and/or a resource. The system's ability to support ecosystem/resource functions and economic benefit is highly affected and irreversible. A large fraction of the local community is affected.
EXTENT	**None** – No spatial effect	**Local (L)** - Isolated effects within project site and its locality.	**Regional (R)** – Extended beyond local area/borders or offsite dispersion pathways.	**National (N)** - Widespread effect affecting the nation (and/or transboundary/international)

Table 8-2 Environmental impact matrix for site preparation and construction phase

CATEGORY		IMPACT	DIRECT/ INDIRECT		DIRECTION			DURATION	MAGNITUDE	EXTENT
			DIRECT	INDIRECT	POSITIVE	NONE	NEGATIVE			
Physical	Drainage and Runoff	Sedimentation and pollution of mangrove forest		X			X	S	M	L
	Water Quality	Sedimentation of marine environment from beach works	X				X	S	M	L
		Pollution of marine environment from fuel, lubricants, hazardous substances from construction equipment	X				X	S	M	L
	Dredging	Increased suspended solids, turbidity, BOD and the reduction in light penetration and dissolved oxygen in the water column	X				X	S	M	L
		Suspension of heavy metals from the substrate	X				X	S	M	L
		Affect sensitive coastal ecological habitats	X				X	S	L	L
	Noise	Noise nuisance from construction equipment on surrounding residential and educational communities	X				X	S	S	L
	Air Quality	Dust nuisance from transportation of raw material on surrounding residential and educational communities	X				X	S	S	L
		Fugitive dust effect on construction workers and residential communities	X				X	S	S	L
Biological	Mangrove Community	Loss of 4.128 hectares (10.18 acres) of mature mangrove forest and less robust mangrove forest	X				X	L	M	L
		Natural closing of drainage pathways affecting hydrology within mangrove forest		X			X	S	M	L
		Urban sprawl and informal settling in neighbouring mangrove forests	X				X	S	S	R
	Terrestrial Fauna	Displacement of the “IUCN Vulnerable” West Indian Whistling Ducks on site	X				X	S	M	L
		Displacement of the “IUCN Near Threatened” Endemic Rock Frog on site	X				X	S	M	L
		Possible presence of crocodiles in the area and interactions with construction workers	X				X	S	S	L
	Coral and Sessile Fauna	Smothering of sensitive nearby coral and reduced light from sedimentation	X				X	S	M	L
		Impaired filter feeding and photosynthesis from prolonged sedimentation	X				X	S	M	L
	Seagrass	Species loss and habitat fragmentation	X				X	L	M	L
		Temporary shading by floating structures/vessels	X				X	S	S	L
		Smothering of seagrass blades and epiphytes from sedimentation	X				X	S	M	L
		Reduced light penetration and resulting decrease in photosynthesis	X				X	S	M	L
		Mechanical abrasion from moorings and anchors	X				X	S	M	L
	Fish and Invertebrates	Temporary loss/displacement of fish habitat	X				X	S	S	L
		Clogging of gills from excess, prolonged sedimentation	X				X	S	S	L
		Reduction in food supply as a result of decreased water quality and change in plankton composition	X				X	S	S	L
	Sea Turtles	Temporary disturbance/displacement from construction activity, lights and noise	X				X	S	S	L
Human/Social	Employment	Creation of direct, indirect and induced jobs	X	X	X			S	M	N
	Solid Waste	Increased generation of solid waste	X				X	S	S	L
	Wastewater	Contamination of marine environment from accidental spillage of portable toilets		X			X	S	S	L
	Vending and Hygiene	Illnesses resulting from improper food handling practices		X			X	S	M	R
		Negative visual effect on area		X			X	S	S	L
	Transportation and Traffic	Effect on traffic travelling on main road				X				
		Effect on vehicles entering and exiting construction site property	X				X	S	S	L
		Effect of overweight vehicles on road surface	X				X	S	S	R
		Accident potential south of Access Road 1	X				X	S	S	R
	Occupational Health and Safety	Potential for accidental injury of construction workers		X			X	S	L	L
		Fugitive Dust effect on health of construction workers		X			X	S	M	L
	Aesthetics	Decreased aesthetic appeal		X			X	S	S	L

CATEGORY		IMPACT	DIRECT/ INDIRECT		DIRECTION			DURATION	MAGNITUDE	EXTENT
			DIRECT	INDIRECT	POSITIVE	NONE	NEGATIVE			
		Trucks leaving the construction site have the potential to deposit marl and mud onto the main road, making the main road aesthetically unappealing.		X			X	S	S	L
	Historical Artefacts	No historical, archaeological features were uncovered. No artefacts were recovered.				X				

Table 8-3 Environmental impact matrix for operation phase

CATEGORY		IMPACT	DIRECT/ INDIRECT		DIRECTION			DURATION	MAGNITUDE	EXTENT
			DIRECT	INDIRECT	POSITIVE	NONE	NEGATIVE			
Physical	Drainage and Hydrology	Increased flood levels within mangrove forest	X		X			L	S	L
		Flooding of adjacent communities	X			X				
		Runoff to drain freely into mangrove forest via ten outfall points	X		X			L	S	L
	Currents	Flushing channel does not significantly change the currents along the project site	X			X				
		Flushing channel helps to draw out any pollutant and reduce the concentration with Negro Bay	X		X			L	M	L
	Sediment Transport	Sediment transport regime remained unchanged	X			X				
		No significant impact to downdrift shorelines	X			X				
Biological	Vegetation	Introduction of invasive alien plant species via landscaping activities can result in their proliferation.		X			X	L	L	R
	Reef Community	Hard structures (groynes, breakwaters, jetty) will provide of ecological volume and substrate for colonization and recruitment		X	X			L	S	L
	Fish	Hard structures (groynes, breakwaters, jetty) will act as Fish Aggregation Devices (FADs)		X	X			L	S	L
	Sea Turtles	Alteration of food source from seagrass bed modification		X			X	L	S	L
		Hard structures act as deterrent from going ashore to nest		X			X	L	S	L
		Noise and lighting act as deterrent from going ashore to nest		X			X	L	S	L
Natural Hazards	Swell Wave Climate	Wave climate unchanged by breakwaters located at Hotel 1	X			X				
		Wave climate reduced by breakwaters located at Hotel 4	X		X			L	M	L
		Swimming areas created at Hotels 2 and 3 have reduced wave energy	X		X			L	M	L
	Hurricane Waves and Storm Surge	Storm surge reduced by breakwaters located at Hotel 4	X		X			L	M	L
		Rocky shoreline at Hotels 2 and 3 at greatest risk from wave damage	X				X	L	M	L
	Climate Change	Flooding from increased rainfall intensity	X				X	L	L	L
		Siltation of drainage systems and coastal areas	X				X	L	M	L
		Sea level rise and resulting increased storm surge	X				X	L	L	L
		Structural Fatigue from increased storm surge	X				X	L	M	L
Human/Social	Employment	Creation of direct, indirect and induced jobs	X	X	X			L	L	N
	Water supply and consumption	Burdening of the water supply in the area in the event of drought conditions.		X			X	S	M	R
	Solid Waste	Increased generation of solid waste	X				X	L	S	L
	Emergency Response	Workers and guests may become ill or have accidents. In addition, disasters such as earthquakes, floods, storm surge and fires are real possibilities.		X			X	L	L	N
	Tourism	Improvement of the tourism product of the country	X		X			L	M	N
	Transportation and Traffic	Traffic travelling along the main road are not significantly affected				X				
		Vehicles entering and exiting the hotel property are expected to experience tolerable delays for short periods	X				X	L	S	L
		A Traffic light will increase the delay for vehicles, thus decreasing the Level of Service	X				X	L	S	L

Table 8-4 Overwater Structures - Environmental impact matrix for site preparation and construction phase

CATEGORY		IMPACT	DIRECT/ INDIRECT		DIRECTION			DURATION	MAGNITUDE	EXTENT
			DIRECT	INDIRECT	POSITIVE	NONE	NEGATIVE			
Physical	Water Quality	Increased TSS/turbidity in water during construction activities (piling installation etc.)	X				X	S	M	L
		Increased TSS/turbidity in water from temporary boulder construction pad	X				X	S	M	L
		Stagnation of water behind the boulder construction pad	X				X	S	M	L
	Noise	Noise impact on surrounding residential and educational communities and construction workers	X				X	S	S	L
Biological	Seagrass	Temporary shading by floating structures/vessels	X				X	S	S	L
		Smothering of seagrass blades and epiphytes from sedimentation	X				X	S	M	L
		Reduced light penetration and resulting decrease in photosynthesis	X				X	S	M	L
		Mechanical abrasion from moorings and anchors	X				X	S	M	L
	Coral and sessile fauna	Smothering and reduced light from sedimentation	X				X	S	M	L
		Impaired filter feeding and photosynthesis from prolonged sedimentation	X				X	S	M	L
	Fish	Temporary loss/displacement of fish habitat	X				X	S	S	L
		Clogging of gills from excess, prolonged sedimentation	X				X	S	S	L
		Reduction in food supply as a result of decreased water quality and change in plankton composition	X				X	S	S	L
	Sea Turtles	Temporary disturbance/displacement from construction activity, lights and noise	X				X	S	S	L
Human/Social	Maritime Traffic	Fishing and other maritime activities affected by construction process	X				X	S	S	L
		Accident potential due to presence of maritime vessels, structures and equipment at sea	X				X	S	L	L
	Health and Safety	Occupational Health and safety of workers (accident potential)	X				X	S	L	L
	Aesthetics	Decreased aesthetic appeal	X				X	S	S	L

Table 8-5 Overwater Structures - Environmental impact matrix for operation phase

CATEGORY		IMPACT	DIRECT/ INDIRECT		DIRECTION			DURATION	MAGNITUDE	EXTENT
			DIRECT	INDIRECT	POSITIVE	NONE	NEGATIVE			
Biological	Reef and Seagrass Communities	Shading from sea rooms (seagrass)	X				X	L	L	L
		Searoom pilings provide ecological volume for coral colonization and recruitment	X		X			L	M	L
	Fish	Searoom pilings and shaded areas will act as Fish Aggregation Devices (FADs)		X	X			L	S	L
	Sea Turtles	Alteration of food source from seagrass bed modification		X			X	L	S	L
		Searoom structures/pilings act as deterrent from going ashore to nest		X			X	L	S	L
		Noise and lighting act as deterrent from going ashore to nest		X			X	L	S	L
Natural Hazards	Climate Change	Design calculations for the proposed concepts included projections for sea level rise to the year 2100			X			L	M	L
	Storm Surge	Potential damage to searooms by storm surge		X			X	L	L	L
	Hurricane Wave Climate	Natural Reef system aids in reduction of wave energy				X				
Human/Social	Maritime Traffic	Maritime activities affected by presence of searooms		X			X	L	S	L
		Accident potential due to possibility of collision with searoom structures		X			X	L	M	L
	Aesthetics	Improvement of the aesthetic appeal of the hotel	X		X			L	M	N
	Emergency Response	Workers and guests may become ill or have accidents. In addition, disasters such as storm surge and fires are real possibilities.		X			X	L	L	N
	Tourism	Improvement of the tourism product of both the hotel and the country	X		X			L	L	N

8.2 SITE CLEARANCE/ CONSTRUCTION

8.2.1 Physical

8.2.1.1 Drainage and Runoff

There is also the potential for sedimentation and pollution of mangrove forest areas due to site run off into the mangroves. The storage of material will have the potential to generate turbidity, sedimentation and possible run-off from site. Rainfall also has the potential to carry the sediments into the mangrove forest.

Recommended Mitigation

A construction drainage plan will be developed to control the discharge of oil/lubricants, sediment and debris into the mangrove areas. Such plans will consist of:

- Site grading
- Sediment retention basins and other measures for minimizing the transport of sediment
    - A sediment basin should also be constructed onsite at a staging area in order to intercept storm water before it is discharged to the mangroves. Typical EPA best management principles recommend the ponds be sized to hold the first flush which equates to 0.25 inches of runoff per impervious acre of contributing drainage area, with an absolute minimum of 0.1 inches per impervious acre. The runoff will then flow into an oil water separator and then be discharge to the mangroves.
- Grease traps and/or oil water separators.

8.2.1.2 Water Quality

Raw materials, for example sand used for beach nourishment activities or marl used in the construction of the proposed hotel, will be stored on site or at a staging area; ground and surface water quality may be prone to increased suspended solids from run-off from construction activities and rainfall events. Boulders to be used for coastal structures (groynes, breakwaters) as well as ironshore excavation for beach creation also have the potential to increase water turbidity.

Stored fuels, lubricants, hazardous substances and the repair of construction equipment have the potential to leak hydraulic fuels, oils, etc and thereby have the potential to compromise water quality as well.

Recommended Mitigation

i. The project site will put in sediment control measures such as turbidity barriers/silt screens and should be erected around the entire work area to prevent the dispersion of sediments and contaminants throughout the water column.
ii. A central area will be designated for the storage of raw materials. This area should be lined in order to prevent the leakage of chemicals into the sediment.

iii. Fine grained materials (sand, marl, etc.) will be stockpiled away from drainage channels and low berms will be placed around the piles which themselves will be covered with tarpaulin to prevent them from being eroded and washed away. Silt fences may also be utilized to prevent siltation.
iv. All boulders used for coastal structures should be washed at a designated area away from the shoreline before being placed in position.
v. Raw materials that generate dust should be covered or wetted frequently to prevent them from becoming air or waterborne.
vi. Raw material and equipment should be stored on impermeable hard stands surrounded by berms to contain any accidental surface runoff.
vii. Bulk storage of fuels and oils should be in clearly marked containers (tanks/drums etc.) indicating the type and quantity being stored. In addition, these containers should be surrounded by bunds to contain the volume being stored in case of accidental spillage.
viii. Refuelling of boats should only be done at anchor out at sea if the sea conditions are calm, otherwise, all refuelling should be done when docked at land. Appropriate refuelling equipment (such as funnels) and techniques should always be used.
ix. Appropriate minor spill response equipment (for containment and clean- up) will kept on site, including oil absorbent pads and disposal bags.
i. In terms of transporting equipment, the paths of the planned roadways will be used, rather than creating temporary pathways just for equipment access.
ii. Raw materials such as marl and sand should be adequately covered within the trucks to prevent any escaping into the air and along the roadway.
iii. Vehicle refuelling facilities must be situated on impermeable surfaces served by an oil trap, run-off collection system. Sediment basins and oil water separators should be constructed to intercept storm water before it is discharged.

8.2.1.3 Dredging Impacts

It is anticipated that there will four (4) different areas along the shoreline to be dredged to accommodate beach works located in the vicinity of Hotels 3 and 4 (Figure 5-28). The estimated amount of dredge spoils to be generated is approximately 6,000 m^3.

Dredging activities may result in deterioration of the water quality of the immediate area as well as some distance away in the direction of prevailing currents. Dredging may result in the increase of suspended solids, turbidity, BOD and the reduction in light penetration and dissolved oxygen in the water column. Suspension of heavy metals from the substrate is also possible and leakages and spillages of oil and solid waste from equipment associated with dredging.

The reduced water quality and light penetration may result in reduced photosynthesis of the seagrass beds nearby. Coral and Other sessile and filter feeding species in the vicinity of the dredge area may be affected by smothering.

Suitable dredged material will be used as fill material on site where needed. Dredge spoil drainage from land may affect coastal water quality and sensitive species in the nearshore area. Dredged material will be placed in a bermed holding area for dewatering after the fines have settled and then the suitable material used as fill on site while the remaining excess material (approximately 200 m^3) will be transferred to trucks and disposed of at an approved disposal site (Retirement Disposal Site, St. James).

Recommended Mitigation

- Turbidity barriers/silt screens are recommended to be used around all dredging activities. These should be placed so as to reduce/contain the resultant sediment plume during these activities. Dredging activities should only occur when these barriers are fully operational, that is; placed correctly; in calm to moderate sea conditions; and without damage. These barriers are particularly important when operations occur near or may influence sensitive ecosystems and species such as coral reefs and seagrass beds and or filter feeding organisms. The silt screens should encircle the areas and be deep enough to contain the plumes so that plumes will not travel in the direction of the prevailing currents.
- Care should be taken to dredge only in approved dredge areas. Dredge areas and a buffer area should be demarcated to avoid accidental dredging in unauthorized areas.
- Dredging operations should be continually monitored to ensure equipment and machinery are in good repair and regularly serviced to prevent oil leaks during regular operations.
- Dredge spoils deposited on land should be placed in a bermed holding area for dewatering after the fines have settle and then the material transferred to trucks to be either disposed of or used on site as fill material if needed.

8.2.1.4 Noise

Site clearance necessitates the use of heavy equipment to carry out the job, including bulldozers, backhoes, jackhammers, etc. These activities and required equipment possess the potential to have a direct negative impact on the noise climate.

Construction noise can result in short-term impacts of varying duration and magnitude. The construction noise levels are a function of the scale of the project, the phase of the construction, the condition of the equipment and its operating cycles, the number of pieces of construction equipment operating concurrently. To gain a general insight into potential construction noise impacts that may result from the project, the typical noise levels associated with various types of construction equipment are identified in Table 8-6.

Table 8-6 Typical construction equipment noise levels

Type of Equipment	Typical Sound Level at 50 ft. (dBA Leq.)
Dump Truck	88
Portable Air Compressor	81
Concrete Mixer (Truck)	85
Jackhammer	88
Scraper	88
Bulldozer	87
Paver	89
Generator	76
Piledriver	101
Rock Drill	98
Pump	76

Type of Equipment	Typical Sound Level at 50 ft. (dBA Leq.)
Pneumatic Tools	85
Backhoe	85

Adapted from - Route 101A Widening and Improvements, City of Nashua Hillsborough County, New Hampshire; McFarland-Johnson, Inc. May 30, 2007

RECOMMENDED MITIGATION

i. Use equipment that has low noise emissions as stated by the manufacturers.
ii. Use equipment that is properly fitted with noise reduction devices such as mufflers.
iii. Operate noise-generating equipment during regular working hours (e.g. 7 am – 7 pm) to reduce the potential of creating a noise nuisance during the night.
iv. Construction workers operating equipment that generates noise should be equipped with noise protection. A guide is workers operating equipment generating noise of ≥ 80 dBA (decibels) continuously for 8 hours or more should use earmuffs. Workers experiencing prolonged noise levels 70 - 80 dBA should wear earplugs.

8.2.1.5 Air Quality

Site preparation comprises various activities such as excavation and land clearing (digging, loading and removal of material by trucks), as well as the storage of raw materials (for example sand and marl) that may potentially have a two-fold direct negative impact on air quality. The first impact is air pollution generated from the construction equipment and transportation of materials. The second is fugitive dust from the proposed construction areas and raw materials stored on or transported to site (potential for materials to become airborne). Fugitive dust has the potential to affect the health of construction workers, the resident population and the vegetation.

RECOMMENDED MITIGATION

i. Areas should be dampened every 4-6 hours or within reason to prevent a dust nuisance and on hotter days, this frequency should be increased.
ii. Minimize cleared areas to those that are needed to be used.
iii. Cover or wet construction materials such as marl to prevent a dust nuisance.
iv. Where unavoidable, construction workers working in dusty areas should be provided and fitted with N95 respirators.

8.2.2 Biological

8.2.2.1 Mangrove Community

Mangrove Loss

The proposed development may result in the loss of 4.128 hectares (10.18 acres) of the most functional and mature mangrove forest (central and northern sections), as well as mangrove areas less robust (southwestern red mangrove forest). These areas include parking and industrial areas, roads, drains and the boardwalk. The breakdown of areas to be cleared of mangroves and their associated quantities are shown in Table 8-7.

Table 8-7 Areas of mangrove to be cleared

	Quantity (Area)		
Areas to be cleared of Mangrove	**m^2**	**Acres**	**Hectares**
Parking and Industrial Area	26,603.39	6.57	2.66
Roads	2,170.80	0.54	0.22
Drain	4,166.02	1.03	0.42
Boardwalk	7,788.74	1.92	0.78
Borehole Access	480	0.12	0.048
Total	**41,208.95**	**10.18**	**4.128**

CARBON DIOXIDE EMISSIONS

The loss of 4.128 hectares (10.18 acres) of mangrove forest equates to the release of 4.7 tonnes of carbon or 17.4 tonnes CO_2 equivalent per year (J. Siikamaki, 2012) (Table 8-8). In other words, the mangroves to be impacted are responsible for sequestering 17.4 tonnes of CO_2/yr.

This is the CO_2 emissions equivalent of consuming 40.3 bbl of oil per year; or the Greenhouse Gas emissions equivalent of an average motor vehicle driving 69,485 km (43,176 miles) per year.

Table 8-8 Carbon stock and burial by mangroves

	Per hectare on average, globally (J. Siikamaki, 2012)		Proposed Project	
	t C	*t CO_2e*	*t C*	*t CO_2e*
Biomass	147.5	540.8	608.9	2232.4
Soil	319.0	1169.7	1316.8	4828.5
Total stock	466.5	1710.5	1925.7	7060.9
Annual accumulation	1.15	4.22	**4.75**	**17.4**

t C (tonnes of Carbon); t CO_2e (tonnes of CO_2 equivalent)

Mitigation for CO_2 emissions is discussed below in Section *"Other Mitigation – Solar Power Generation".*

GENERAL MITIGATION

Mangrove rehabilitation is proposed in select degraded areas. Approximately 8.68 acres of potential mitigation/compensation areas were found within the property boundary (Figure 8-1). These potential mitigation areas are dominated by *Acacia sp*., mangrove ferns and *Dalbergia sp* (wetland flora) but no mangrove species within the centres.

Sites 2, 4 and 5 were mandated for rehabilitation by NEPA. Site 1 and 3 are proposed mitigation areas for mangrove rehabilitation. Details on each rehabilitation site are discussed below.

Figure 8-1 Proposed mangrove rehabilitation areas

REHABILITATION SITE 1

Rehabilitation Site 1 (3.3 acres) is not slated for hotel development and may be restored to optimal hydrology with the installation of culverts to connect it to the north-eastern mangrove area.

REHABILITATION SITE 2

Rehabilitation Site 2 (2.63 acres) is located at the south of the property. This area is dominated by *Acacia sp.* trees, grasses, Lead trees and other non-mangrove vegetation. The area receives fresh water during rains and is raised above the normal mangrove forest level. Being adjacent to a very mature mangrove forest, it may be altered to optimal topography and drainage to be converted (or reverted) to a functional mangrove forest.

REHABILITATION SITE 3

Rehabilitation Site 3 (0.25 acres) is located toward the north eastern end of the property and is a degraded mangrove forest (Plate 8-1). Instead of being used to rehabilitate mangrove, this area could be excavated and channelled to form a drainage catchment for the highway storm water, releasing nutrient/sediment rich waters slowly into the northeastern mangrove area (which eventually exits through the visible tidal creek).

Plate 8-1 Section of degraded mangrove forest at north-eastern end of property

REHABILITATION SITE 4

Rehabilitation Site 4 (1.75 acres) is located toward the southwestern end of the property. This area showed evidence of mangrove tree clearing and reclamation by marl-like material. Mangrove recruits are present on the edges and the area may be altered to have a sunken topography for drainage catchment. A natural creek leading northwest to the mangrove forest was observed. This area should be maintained to provide exchange to the western high-saline red mangrove system as it would assist with the mangrove forest health in that area. The excess drainage from this area would exit the property to the southwest as it does currently.

REHABILITATION SITE 5

Rehabilitation Site 5 (0.75 acres) is an identical filled area to that of Site 4 and is located just east of Site 4, across the road. This area could be excavated and culverted to lead west to connect with Site 4 and eventually to the high-saline red mangrove system. Detailed wetland design and engineering will be needed to accomplish this.

POTENTIAL REHABILITATION SITE OUTSIDE OF PROPERTY BOUNDARY

Another raised and potential mitigation site (1 acre) extends north of Rehabilitation Site 3 and is much larger with a length of 75m and a width of 55m. This area revealed the presence of human activities (bee keeping) as seen in Plate 8-2.

Plate 8-2 Evidence of bee farming at potential mangrove rehabilitation site north of Site 3

BOARDWALK CONSTRUCTION MITIGATION

Construction of the boardwalk and other features within the mangrove must utilize the following guidelines:

- The boardwalk should be constructed in stages (finishing one section and moving on in a continuous buildout plan) and without the use of heavy equipment to reduce the potential impact area.
- Construction should not be undertaken during periods of heavy rain/ rainy season.
- Construction materials should be natural and blend in with the forest to reduce the visual impact of fauna. The materials should be strong, rust resistant and should not be treated with chemicals which may leach into the environment.
- The use of hazardous or toxic substances should not be undertaken in or near waterways.
- Older and larger trees should be avoided

OTHER MITIGATION

Reduction of Parking Spaces

Parking and Industrial Areas alone require 6.57 acres of the 10.18 acres of mangrove forest to be cleared (Table 8-7). Discussions will be had with the Hanover Municipal Corporation to request a reduction in the number of parking spaces needed. During hotel operations, it is anticipated that the majority of hotel guests and staff will be transported by buses, hence a request for a reduction in the number of parking spaces would be a practical and feasible one.

Solar Power Generation

From an ecological standpoint, mangrove rehabilitation, which was discussed in previous sections, is the recommended mitigation for mangrove loss.

From an emissions standpoint, the use of solar power generation is the recommended mitigation for mangrove loss. The projected amount of CO_2 emissions per year from hotel operations using natural gas and heavy fuel oil is shown in Table 8-9 below. Table 8-9 also displays the reduction in the amounts of CO_2 emissions per year from using solar power generation compared to Heavy Fuel Oil and Natural Gas.

Table 8-9 Projected amount of CO_2 emissions per year from hotel operations using natural gas and heavy fuel oil and the comparative reduction in emissions from using solar power generation.

	Natural Gas	Heavy Fuel Oil
CO_2 Emissions per year (tonnes CO_2 /yr)	23,100	27,300
Reduction in CO_2 emissions from using solar power generation (tonnes CO_2 /yr)	20,664	24,864

Previous calculations (Table 8-8) showed that the impacted mangroves sequestered 17.4 tonnes of CO_2 /yr. Using solar power generation as a mitigative measure for mangrove loss therefore results in a net positive reduction in CO_2 emissions compared to the amount of CO_2 which the mangroves would have sequestered.

Water Flow Disruption

The northeastern mangrove area (Transects 9 and 10) is tidal to a large extent, has mixing to the south and shows evidence of sporadic fresh water exit during rain events. Individual mangrove trees occasionally close their natural drainage pathways, which may affect an entire forest (R. Lewis et. al., 2016).

MITIGATION

The very visible tidal creek (adjacent to Transect 9) should be maintained with little or no disturbance. It may be beneficial to erect a concrete structure in this location to prevent natural mangrove forest growth which may enclose this vital exchange point. This system should be engineered to be more optimally connected to the middle mangrove forest, west of the “service road”. Currently only one culvert connects these forest segments. The culvert was observed to flow seaward only at a moderate pace during heavy rain events.

Socioeconomic Impact

Traditionally in Jamaica, large numbers of labourers and skilled workers travel to communities undergoing large construction projects (such as this proposed project). This primarily lower income workforce is unlikely to have sufficient and affordable housing available to them in Green Island. Temporary workers may resort to informal settlements in close vicinity to the work site. The parish of Hanover boasts 749.40 hectares of wetlands (National Environment and PLanning Agency, 2010) and it was observed that the Green Island area has a fair number of wetlands in which suspected informal settlements have been observed. Anecdotal discussions revealed that these lands are primarily government lands or lands ignored by private landowners.

MITIGATION

Steps must be taken by the Contractor and respective agencies to not only conserve the wetlands at the proposed impact site, but also prevent further informal settlement sprawl in other neighbouring wetlands.

8.2.2.2 Terrestrial Fauna

Avifauna

The West Indian Whistling Ducks (*Dendrocygna arborea*) observed are of some concern and are listed as 'vulnerable' on the IUCN red list. Some of the birds will be displaced as a result of the development. However, the majority of the birds found on the property have become accustomed to urban life and are expected to transition without difficulty or find adjacent habitat. Construction activities may result in both resident and migrant species avoiding the project area during construction activities.

MITIGATION

Efforts should be made to retain areas of the wetland habitats for the ducks. This may include the development of bird sanctuary. Boardwalk viewing areas should also be created for education and bird watching.

Construction (the Boardwalk in particular) should be done during non-nesting times (or other sensitive periods) or limited if this is unavoidable.

Bats

The proposed development may have a minimal impact on the bat community. There were no major roosting areas on site proposed (no caves or manmade structures). No bats were observed drinking from the freshwater bodies on the property. It's possible that loss of freshwater sources may impact the bats. The critically endangered Jamaican Flower bats have been reported in the Parish of Hanover. However, it is unlikely that they would be foraging on the property as vegetation is dominated by mangroves and few flowering plants.

Mitigation

Efforts should be made to retain areas of the wetland habitats and almond trees which can be preserved and integrated in the landscaping plan for the property.

Herpetofauna

Given the possibility of the presence of crocodiles within the project area, the contractors and construction crew should be aware of their surroundings.

The endemic rock frog (*Eleutherodactylus cundalli*) is "near threatened" on the IUCN Red List.

MITIGATION

The site should be fenced, and signage should be placed around the site informing and educating construction crews about the possibility of crocodiles and what to do if one is observed. Any sighting of a crocodile in the area at any stage of the project should be reported to the National Environment and Planning Agency (NEPA).

Efforts should be made to preserve some of the mangrove trees and associated bromeliads (primary habitat for the endemic rock frog *Eleutherodactylus cundalli*) on the property.

8.2.2.3 Marine Environment

The surrounding benthic and intertidal community including seagrass, hard corals, fish, urchins and other invertebrates may be impacted by sedimentation and smothering, habitat fragmentation/loss, increased water turbidity and suspended solids and some species loss. As a result, the following mitigation measures should reduce the potential impact to the biological environment.

Primary Mitigation Measures

1. During construction, the project site should include sediment control measures such as turbidity barriers/silt screens and should be erected around the entire work area to prevent the dispersion of sediments and contaminants throughout the water column. These should be placed so as to reduce/contain the resultant sediment plume during the activities. Construction activities should only continue when these barriers are fully operational, that is; placed correctly; calm to moderate sea conditions; without damage. These barriers are particularly important when operations occur near or may influence sensitive ecosystems and species such as coral reefs and seagrass beds and or filter feeding organisms and fish.
2. Weekly monitoring of water quality parameters such as temperature, salinity, pH, Dissolved Oxygen, light irradiance, turbidity and Total Suspended Solids (TSS) in and around the project area should be conducted during construction for the first 3 months of construction. Monitoring can be conducted fortnightly thereafter.
3. Conduct sediment dispersal calculation rates on coral reefs and seagrass beds within 200 meters of the proposed villas and at control stations, on a monthly basis, for comparison to background levels. Pre-construction sedimentation rates should therefore also be conducted and used as a baseline for comparison.

4. All activities should be limited to the minimal working area, and as such reducing the extent of the footprint. No activities and or placement of anchors or materials should be done placed outside the approved area.
5. Relocation of sensitive species should be done if; they are suitable for relocation (that is suitable substrate, health and over all viability), those species fall within the potential impact area; and if mobile invertebrates are in or around the potential impact area. Sensitive organisms and systems in and outside the impact area include; hard and soft corals, sponges, seagrass and mobile invertebrates such as urchins, sea cucumbers, starfish and conch. **Detailed Seagrass and Coral Removal and Relocation Plans, as well as a Post-Relocation Monitoring Plan, must be prepared for approval by NEPA.**
6. Alternative mitigations should be proposed when relocation is unlikely to be successful.
7. Where possible, as little of the natural environment should be relocated or removed. Habitat fragmentation and species displacement should be temporary, with the placement of silt screens, construction materials and equipment as well as general human activity in the area.
8. Structures placed on the seafloor may cause habitat fragmentation and displace some species, however they may also serve to add ecological volume, providing substrate for organisms to settle and colonize and eventually may serve some ecosystem functions.
9. Any temporary floating structures and /or vessels should be placed in areas with less sensitive species where possible. Floating structures anchored or moored over seagrass beds or coral colonies should not be left for prolonged time periods as the resulting shading effects may cause deterioration in overall health of the seagrass bed and coral colonies.

Coral Community

The marine works are in a shallow nearshore pavement community which may be periodically exposed and stressed, such colonization is low. The pavement is dominated by turf and macroalgae, with small encrusting species such coral colonies, rock boring urchins were seen here (density and diversity here is very low). Some section within the footprint have small patches of seagrass, sponges and small loose colonies of *Porites divaricata*. Standard Quantitative measures along transect lines, quadrats or photographs are difficult and as such quantification of this community was difficult. An estimated 165 hard corals may be impacted by the marine works. The *divaricata* colonies are mobile and not considered part of the overall total relocation numbers and do not require typical coral relocation methodologies. These colonies will be gathered and moved to seagrass areas outside the working footprint prior to any works. Corals encrusting in pavement are unsuitable for relocation, most corals in the impact areas are small and encrusting. Larger massive coral colonies (approximately 60 hard corals) will be relocated to similar nearby areas outside of the working footprint.

There exists an extensive reef system, including several small thickets and individual colonies of *Acropora cervicornis*. The reef systems surrounding the nearby project area were all highly stressed and undergoing a massive bleaching event along with outbreaks of disease. Coral cover, density and diversity as well as reef structure vary, however these nearby features require extreme care during site preparation and construction. Coral colonies further west of the proposed site may also be affected by sedimentation and associated waves and currents which carry these sediments.

Recommended Mitigation: See Primary Mitigation Measures 1-9 above.

Seagrass

The seagrass beds mapped within the project footprint and the resulting seagrass area to be impacted may be seen in Figure 8-2. Sections of the project footprint lie within an expansive seagrass bed in Negro Bay and beds along the coastline.

A 3-metre buffer outside of the project footprint was applied to account for the active working area and accidental seagrass damage during construction.

Approximately **10,676.81 m^2** of seagrass located within the entire project footprint will be impacted for various project features. The total impact areas per species for the entire project area is as follows:

- 10,579.81 m^2 *Thalassia*;
- 84.46 m^2 *Halodule*;
- 4.96m^2 mixed bed of *Syringodium* and *Halodule*;
- 4.81m^2 mixed bed *Thalassia* and *Halodule*;
- 2.77m^2 *Syringodium*.

Construction activities associated with the hotel development and beach works may result in the mortality of seagrasses and associated biota within the project footprint. Seagrasses and associated biota around the project area but not directly within the footprint may also be affected by sedimentation and smothering from construction activities. The main potential impacts to the marine environment as a result of site preparation and construction activities are; Species loss/displacement, habitat loss/fragmentation, excess sedimentation and reduced water quality.

Recommended Mitigation: See Primary Mitigation Measures 1-9 above

INDIVIDUAL SEAGRASS SURVEY SITES

Figure 8-2 displays the overall seagrass impact areas throughout the entire project footprint area.

Site 1 involves the overwater searooms, shown in Figure 8-3, but is discussed in Section 8.4.1.2.

Site 2 is located to the Western end of Negro Bay and includes a section of land which will be cut to create a flushing channel into the bay. The area is divided into two main substrate types; Pavement to the northern end and muddy substrate to the southern end. The potential seagrass impact area is 3,178.15 m^2, comprised of 3,166.94 m^2 *Thalassia* (including short bladed *Thalassia*), 6.4 m^2 of

Halodule and 4.81 m² of mixed *Thalassia* and *Halodule* beds. (Figure 8-3). An estimated 50% of this total area can undergo relocation based on suitable substrate type.

Site 3 is located to the East of Negro Bay Point and consists of mainly pavement substrate, with few small muddy zones. This location may impact 512.08 m² of *Thalassia* (Figure 8-4). None of the seagrass located in this area can undergo relocation because of unsuitable substrate type.

Site 4 is located towards the centre of the Negro Bay Point coast and consists mainly of pavement substrate. This location may impact 279.09 m² of *Thalassia* (Figure 8-4). None of the seagrass located in this area can undergo relocation because of unsuitable substrate type.

Site 5 is located to the West of Negro Bay Point, into Green Island Harbour. The area consists of mainly pavement, with patches of sand closer to the shore and muddy areas moving into Green Island Harbour. The total area of seagrass that could be affected is 1,354.32 m², comprised of 1,330.52m² *Thalassia*, 16.07m² *Halodule*, 2.77 m² *Syringodium* and 4.96 m² of mixed *Syrindodium* and *Halodule* beds (Figure 8-5). None of the seagrass located in this area can undergo relocation because of unsuitable substrate type.

Site 6 is located in Green Island Harbour to the West of the project area. The area consists of sandy substrate towards the coast, transitioning into pavement and mud moving south into the bay. The total impacted seagrass area is 226.99 m², comprised of 170.44 m² *Thalassia* and 56.55 m² *Halodule* (Figure 8-5). An estimated 5% of this total area can undergo relocation based on suitable substrate type.

SEAGRASS RELOCATION SITES

Of the 10,676.81 m² of seagrass (All 6 survey sites) to be impacted by the overall proposed project works, approximately 6,726.61 m² is deemed suitable for relocation. The proposed seagrass replanting site (5,469 m²) is displayed in Figure 8-6. Monetary compensation is recommended for the remainder of seagrass (1,257.61 m²) for which no suitable space for relocation can be found or seagrass that is unsuitable to be moved. Discussions will be had with NEPA regarding any financial compensation .

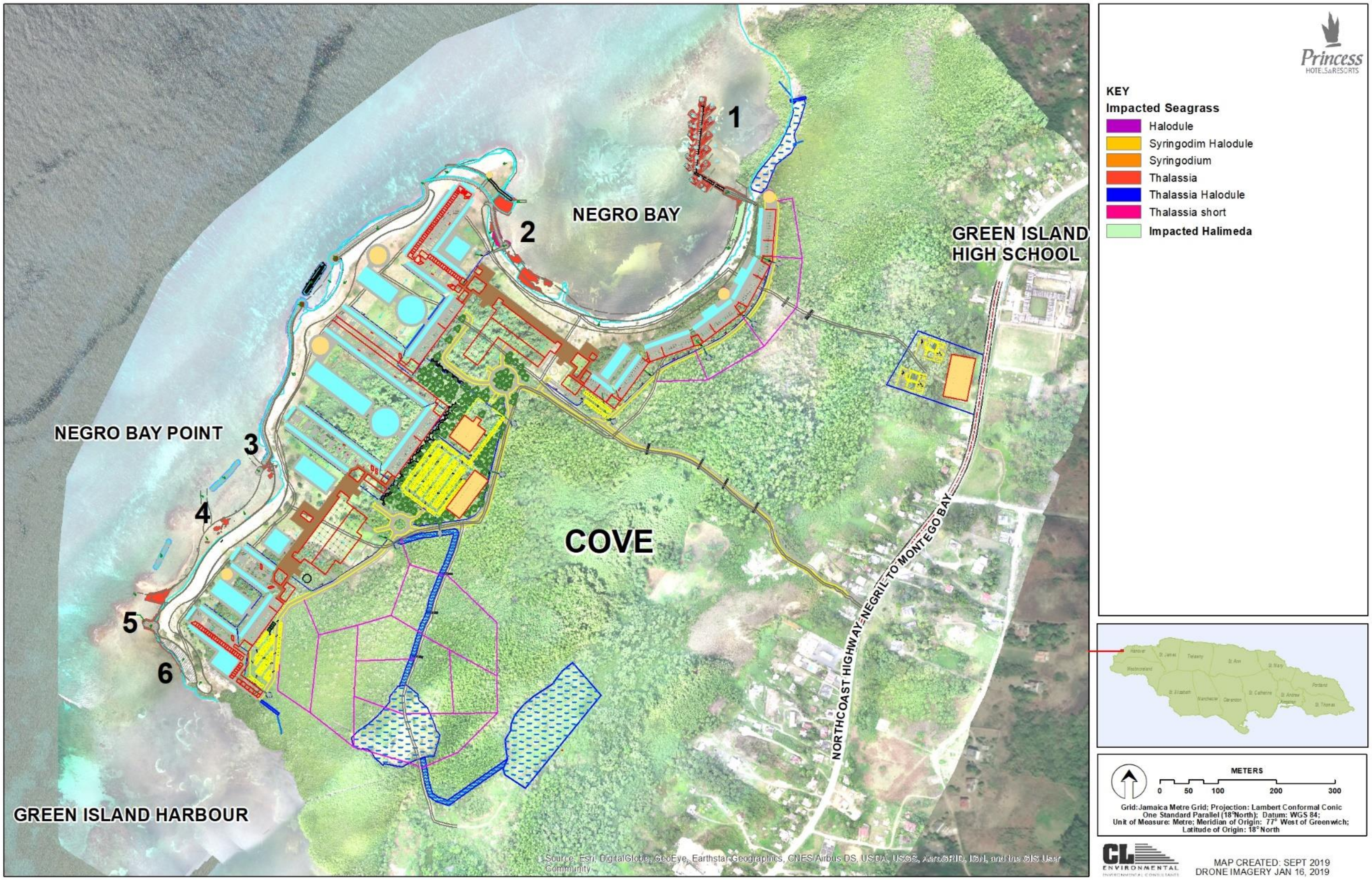


Figure 8-2 Total Impacted Seagrass Area Within Project Footprint

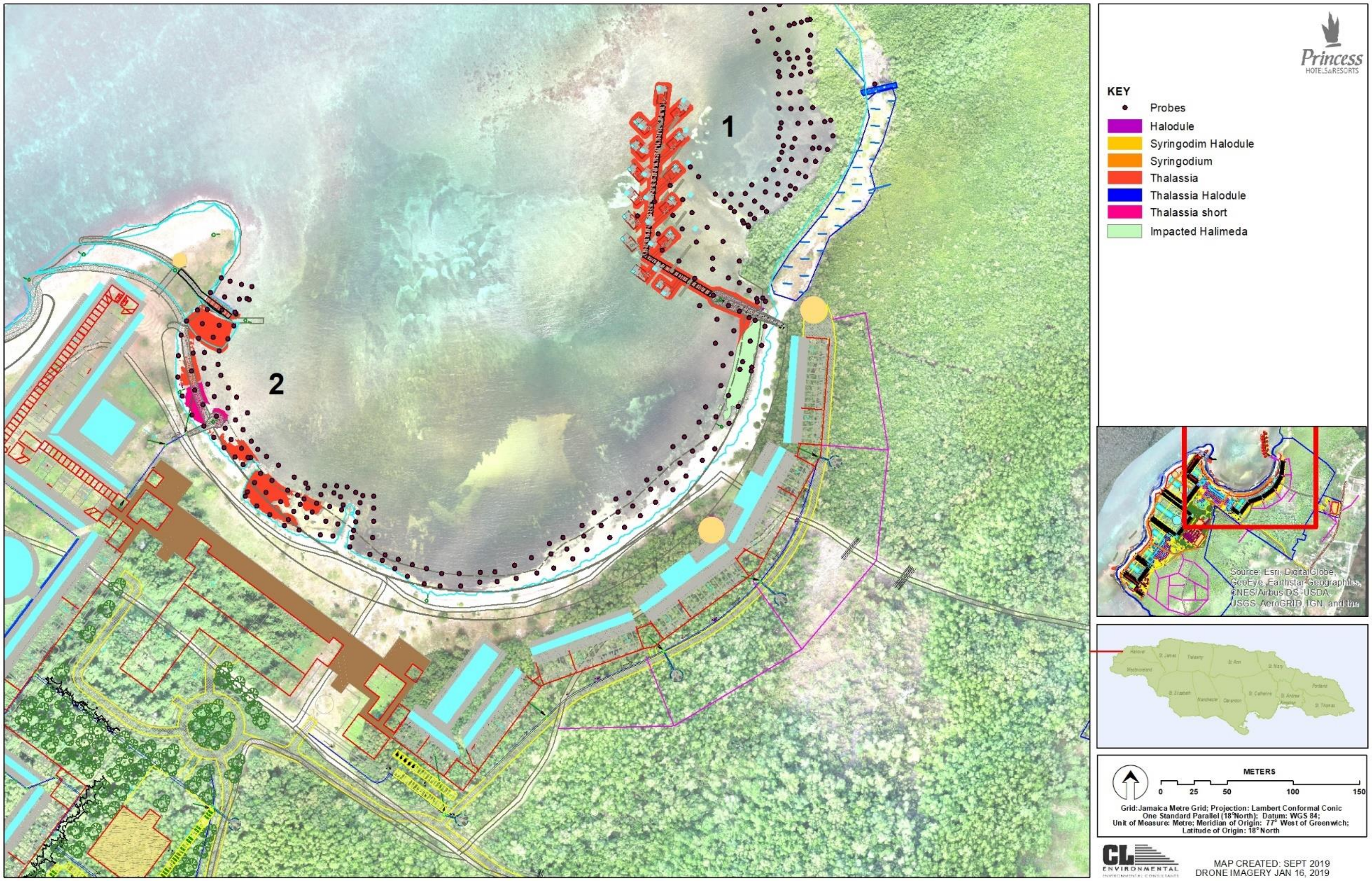


Figure 8-3 Impacted Seagrass and Sediment Probes for Negro Bay Sites 1 and 2

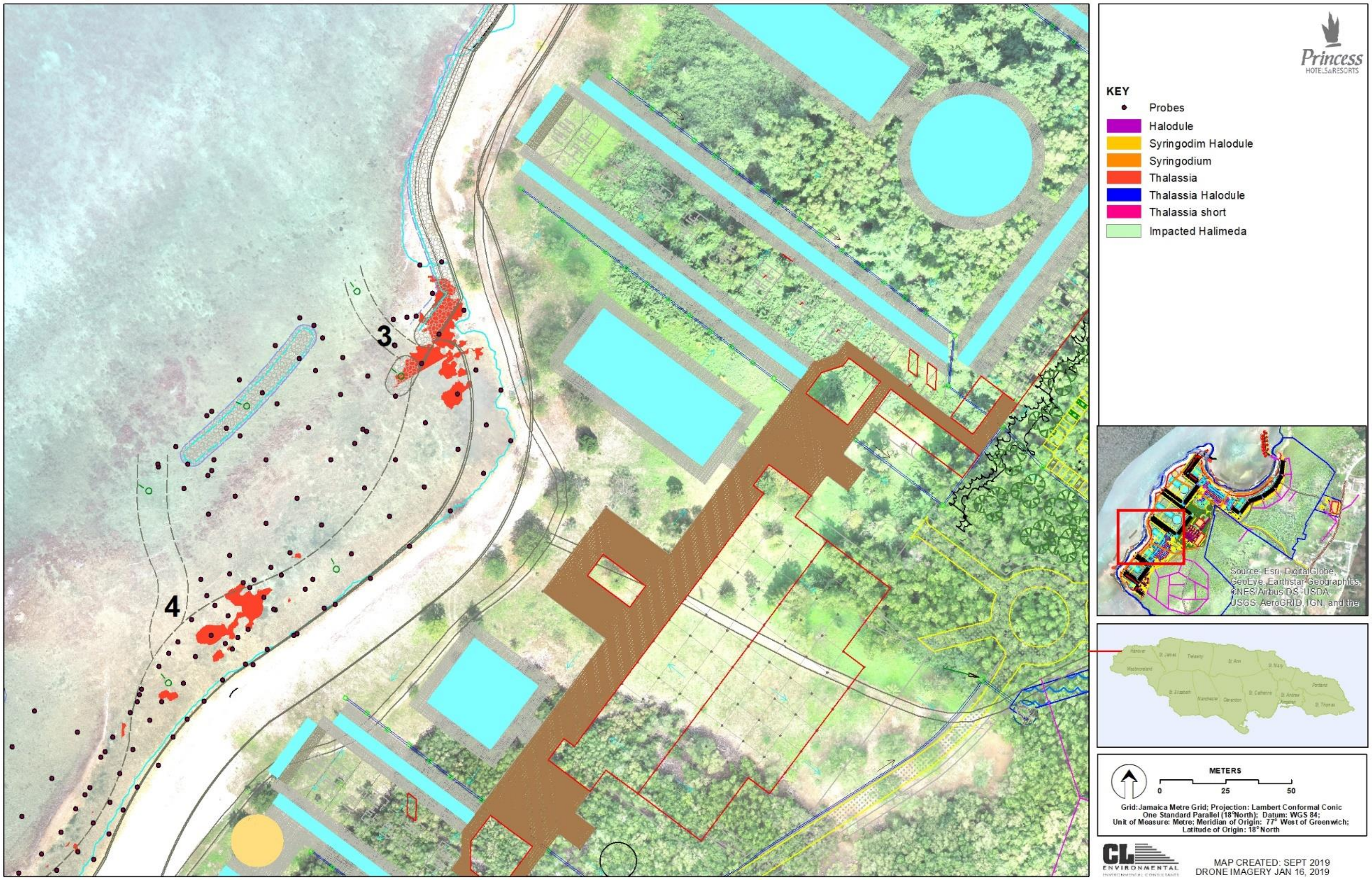


Figure 8-4 Impacted Seagrass and Sediment Probes, Negro Bay Point Sites 3 and 4

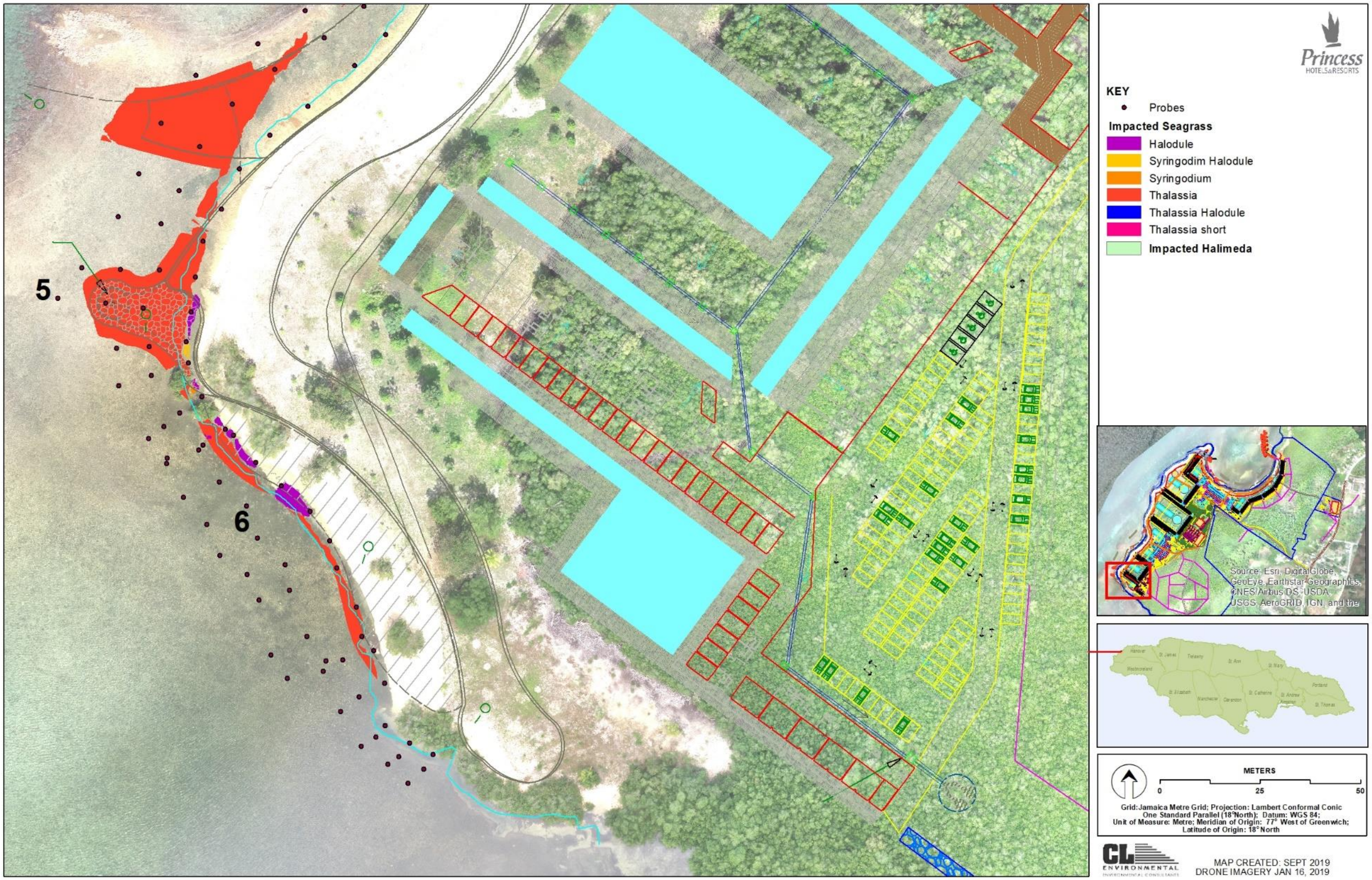


Figure 8-5 Impacted Seagrass and Sediment Probes for Negro Bay Point/Green Island Harbour Area, Sites 5 and 6

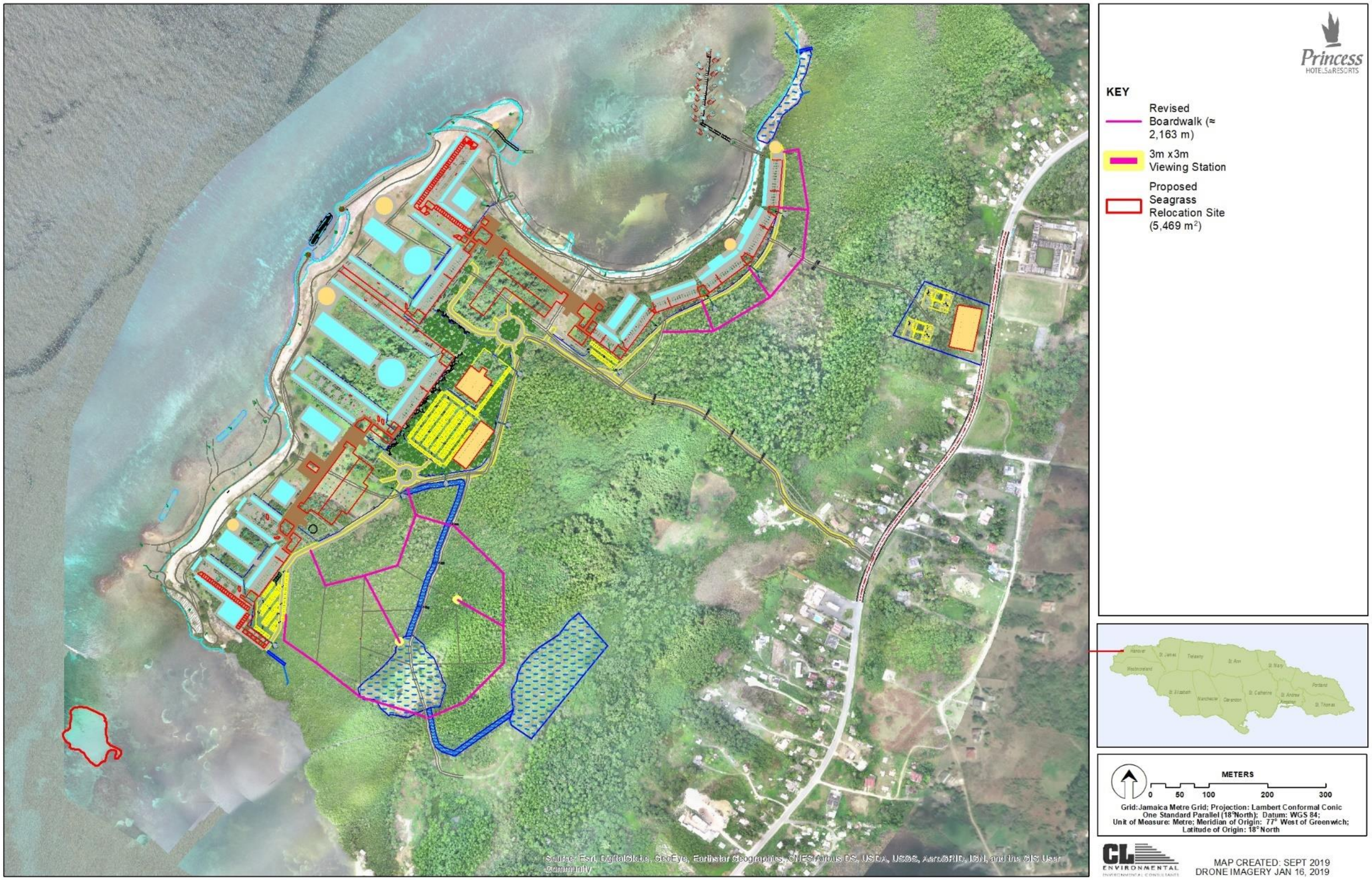


Figure 8-6 Proposed Seagrass Relocation Site

Fish and Invertebrates

Site preparation and construction activities may result in the temporary loss and/or displacement of any fish/invertebrate species and habitat. The excess sedimentation may result in clogging of fish gills and may result in their death. There may be a reduction in food supply as a result of reduced water quality and the resultant changes in the plankton composition.

Recommended Mitigation: See Primary Mitigation Measures 1-4 above.

Sea Turtles

Site preparation and construction activities may result in the temporary displacement of any sea turtles that utilize the general area for foraging and nesting. Displacement may occur as a result of; silt screens and other barriers and equipment being utilized, this may prevent/limit access to various habitats and pathways (fragmentation).

Nesting turtles maybe particularly sensitive to varying and increased noise (Wendy E.D Piniak, 2016). Studies carried show that turtle have auditory cues however the impact of noise on their ecology is not fully known. The turtle activity in the area is carefully monitored.

Lighting used during any night-time construction activities has the potential to interfere with nesting and navigation of some species.

RECOMMENDED MITIGATION

i. Attempts should be made to schedule the majority of the construction period outside of turtle nesting season (May – October).

ii. All staff and workers should be sensitized to the all sensitive ecosystems and species in the area, in particular turtles. The site should be inspected daily for any signs of turtle activity. If a nest is suspected or found, all activity nearby should stop until an expert can determine if there is a nest and how to relocate the eggs.

iii. The stakeholders, proponents and the NEPA should develop clear lines of reporting and communication in the event that action needs to be taken.

iv. Silt screens should be used to prevent sedimentation but should be removed promptly along with any other construction debris and material upon completion.

v. Night-time activities should be limited or avoided when possible. No lights should be pointed out to sea confusion and disorientation of turtles or any other species that maybe affected by lunar activity.

vi. Fixtures in direct line-of-sight from the beach should be shielded down-light only fixtures or recessed fixtures having low wattage "bug" type bulbs and non-reflective interior surfaces.

vii. Fixtures mounted as low in elevation as possible through use of low-mounted wall fixtures, low bollards and ground level fixtures.

viii. Floodlights, up-lights or spotlights for decorative and accent purposes that are directly visible from the beach or which indirectly or cumulatively illuminate the beach shall not be used.

ix. For high intensity lighting applications such as providing security and similar applications shielded low-pressure sodium vapour lamps and fixtures shall be used.

Ecological Enhancement Plan

As part of a holistic mitigation strategy for the proposed project, an overall Ecological Enhancement Plan could provide additional support and compensation with mutually beneficial and long-term goals. The proposed development will aim to preserve and enhance the project area as well as the larger Protected Area, by creating conservation areas and projects as well providing support to the local NGO's Agencies and stakeholders. The hotel seeks to incorporate eco-tourism activities, such as; creating a sea turtle nesting and monitoring program, bird watching and bird sanctuary, mangrove rehabilitation sites, reef rehabilitation and fish management areas, along with existing Protected Area projects. Similar programs have been successfully implemented in Oracabessa and are being established in Montego Bay and other areas. Several activities can be taken on individually or as part of a larger project and management team.

Mel Tennant, the head of the Oracabessa Turtle Project, has provided a general outline as part of the management program;

- Develop an association or co-operative with fishermen, providing guidance, enrolling members and setting up a committee.
- Work with the fishermen and other stakeholders to set up the no-fishing area and setting up a temporary boundary.
- Have the area gazetted once all stakeholders are in agreement.
- Major costs associated include; equipment, boat, office space, training of wardens, sanctuary managers and staff (provided by sponsorship).
- The Sanctuary should be run by a committee that has equal numbers of fishers and hotel personnel.
- The Sanctuary undertakes various activities with sponsors - as coral, turtle monitoring, including tagging and hatchling release. These activities also allow participation of hotel guests and staff.

All recommended mitigation measures previously listed (for mangrove, terrestrial fauna, seagrass, coral, fish and turtles) should form part of this overall Ecological Enhancement Plan.

8.2.3 Socioeconomic/Cultural

8.2.3.1 Employment

The work force for the site will at peak time be approximately 1,500 trade men and labourers and should range from 700 -1500 during construction. This should create approximately 2,660 - 5,700 indirect and induced jobs during construction. This represents a significant level of employment within the study area and has the potential to be a significant positive impact. It is anticipated that some labourers will be from sourced from nearby communities.

Mitigation

No mitigation required.

8.2.3.2 Solid Waste Generation and Disposal

During this construction phase of the proposed project, solid waste generation may occur mainly from the following points:

i. From the construction campsite.
ii. From general construction activities including site clearance and excavation.

The USEPA estimates from surveys of non-residential low-rise construction that the average rate of solid waste generation is 22.95 Kg/square metre (or 1.6 to 8.5 lb/ft^2 (5.05 lb/ft^2))[7]. With an estimated 340,000 m^2 (3,659,729.54 ft^2) of building floor area, then the estimated construction solid waste is 8,383.12 tonnes. Figure 8-7 and Table 8-10 shows the typical breakdown of this waste.

Given the estimated volume of construction solid waste (8,383.12 tonnes / 5,781.46 m^3), the estimated number of disposal trips via 20m^3 dump truck is 289 trips.

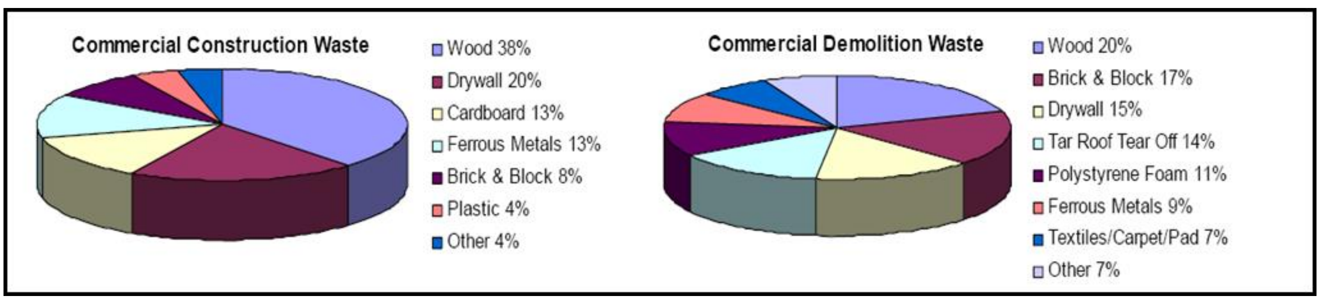


Figure 8-7 Composition of construction and demolition waste [8]

[7] Estimating 2003 Building Construction and Demolition Material, USEPA
[8] "Construction and Demolition Waste Management Toolkit," WasteCap Wisconsin, June 2005

Table 8-10 Estimated construction solid waste generation

BUILDING SIZE		3,659,729.54 ft²	3,659,729.54 ft²		
GENERATION RATE		LOW 1.6 lb/ft²	HIGH 8.5 lb/ft²		
MATERIAL	COMPOSITION (%)	LBS	LBS	LOW TONNES	HIGH TONNES
Wood	38	2,225,115.56	11,820,926.41	1009.29	5361.88
Drywall	20	1,171,113.45	6,221,540.22	531.208	2822.04
Cardboard	13	761,223.74	4,044,001.14	345.285	1834.33
Ferrous	13	761,223.74	4,044,001.14	345.285	1834.33
Brick/Block	8	468,445.38	2,488,616.09	212.483	1128.82
Plastic	4	234,222.69	1,244,308.04	106.242	564.408
Other	4	234,222.69	1,244,308.04	106.242	564.408
TOTAL	100	5,855,567.26	31,107,701.09	2656.04	14110.2
AVERAGE		18,481,634.18		8383.12	

RECOMMENDED MITIGATION

i. A Solid Waste Management Plan will be done and is to be approved by the National Environment and Planning Agency (NEPA) and the National Solid Waste Management Authority (NSWMA).
ii. Skips and bins should be strategically placed within the campsite and construction site.
iii. The skips and bins at the construction campsite should be adequately designed and covered to prevent access by vermin and minimise odour.
iv. The skips and bins at both the construction campsite and construction site should be emptied regularly to prevent overfilling.
v. Disposal of the contents of the skips and bins should be done at an approved disposal site – Retirement Disposal Site, St. James.

8.2.3.3 Wastewater Generation and Disposal

With every construction campsite comes the need to provide construction workers with showers and sanitary conveniences. Portable toilets and the disposal of same have the potential to contaminate the marine environment in the event of accidental spillage.

Mitigation

i. Provision and maintenance of portable sanitary conveniences for the construction workers for control of sewage waste by a licenced contractor. A ratio of approximately 25 workers per chemical toilet should be used.
ii. Showers should be provided for the workers.
iii. Portable toilets should be located at a distance away from the shoreline to avoid discharge into the marine environment in the event of accidental spillage.

8.2.3.4 Vending and Food Hygiene

The establishment of a construction campsite will cause a proliferation of "cook shops" (food vendors) to provide the construction workers with meals. Improper food preparation and the failure to practice proper hygiene can result in certain pathogens entering the food supply and cause food borne illness. Food borne illness often presents itself as flu likes symptoms such as nausea, vomiting, diarrhoea or fever. This will also have a negative visual effect on the proposed construction site.

Mitigation

i. Provision of adequate supply of potable water.
ii. The monitoring of the various "cook shops" by public health authorities and the construction management team, to ensure proper hygiene is being followed.
iii. The provision of areas to adequately wash hands and utensils.

8.2.3.5 Transportation and Traffic

Level of Service

Level of Service (LOS) describes the general comfort and efficiency related to traffic on roads. It can be thought of as a measure of quality of traffic service along a particular corridor. LOS is most often measured in terms of delay and is assigned grades using letters from "A" to "F", with "A" being the most desirable and 'F' the least. It was necessary to determine the level of service for the construction phase of the hotel development. This allows for the determination of the anticipated delays on the current highway traffic as well as formulation of the relevant mitigation steps to minimize any anticipated delay(s).

The analysis was undertaken using the capacity analysis methodology published in the Highway Capacity Manual[9]. Capacity analysis is a set of procedures employed in estimating the traffic carrying ability of roadway based on operational conditions. The level of service analysis for the un-signalized intersections was performed using Sidra Intersection 8.0 Traffic analysis software. The efficiency of traffic operations was measured with the Level of Service (LOS) grading system. Evaluation of the roadway and associated intersections involved the assignment of grades from "A" to "F" with "A" representing the highest level of operating conditions and "F" representing extremely congested and restricted operations. describes each category of Level of Service as presented by the Highway Capacity Manual.

[9] Transportation Research Board; "Highway Capacity Manual: 2000 Edition"; 2000.

Table 8-11 Categories of Level of Service

Level of Service Descriptions	
Level of Service (LOS) Category	**Category Characteristics**
A	free flow. Traffic flows at or above the posted speed limit and motorists have complete mobility between lanes. The average spacing between vehicles is about 550 ft(167m) or 27 car lengths. Motorists have a high level of physical and psychological comfort. The effects of incidents or point breakdowns are easily absorbed. LOS A generally occurs late at night in urban areas and frequently in rural areas.
B	reasonably free flow. LOS A speeds are maintained, maneuverability within the traffic stream is slightly restricted. The lowest average vehicle spacing is about 330 ft (100 m) or 16 car lengths. Motorists still have a high level of physical and psychological comfort.
C	stable flow, at or near free flow. Ability to maneuver through lanes is noticeably restricted and lane changes require more driver awareness. Minimum vehicle spacing is about 220 ft (67 m) or 11 car lengths. Most experienced drivers are comfortable, roads remain safely below but efficiently close to capacity, and posted speed is maintained. Minor incidents may still have no effect, but localized service will have noticeable effects and traffic delays will form behind the incident. This is the target LOS for some urban and most rural highways.
D	approaching unstable flow. Speeds slightly decrease as traffic volume slightly increase. Freedom to maneuver within the traffic stream is much more limited and driver comfort levels decrease. Vehicles are spaced about 160 ft(50m) or 8 car lengths. Minor incidents are expected to create delays. Examples are a busy shopping corridor in the middle of a weekday, or a functional urban highway during commuting hours. It is a common goal for urban streets during peak hours, as attaining LOS C would require prohibitive cost and societal impact in bypass roads and lane additions.
E	unstable flow, operating at capacity. Flow becomes irregular and speed varies rapidly because there are virtually no usable gaps to maneuver in the traffic stream and speeds rarely reach the posted limit. Vehicle spacing is about 6 car lengths, but speeds are still at or above 50 mi/h (80 km/h). Any disruption to traffic flow, such as merging ramp traffic or lane changes, will create a shock wave affecting traffic upstream. Any incident will create serious delays. Drivers' level of comfort become poor.[1] This is a common standard in larger urban areas, where some roadway congestion is inevitable.
F	forced or breakdown flow. Every vehicle moves in lockstep with the vehicle in front of it, with frequent slowing required. Travel time cannot be predicted, with generally more demand than capacity. A road in a constant traffic jam is at this LOS, because LOS is an average or typical service rather than a constant state. For example, a highway might be at LOS D for the AM peak hour, but have traffic consistent with LOS C some days, LOS E or F others, and come to a halt once every few weeks. Most design or planning efforts typically use service flow rates at LOS C or D, to ensure an acceptable operating service for facility users.

Under the HCM 2000 methodology, delay is calculated only for those movements that must stop and wait until a sufficient gap is available. Delay is reported in terms of average seconds per vehicle and given a corresponding letter grade for each movement rather than the intersection as a whole. The ranges of LOS grades and criteria for stop controlled intersections are given below (Table 8-12).

Table 8-12 Level of Service for Un-Signalized Intersections

Level of service	Description of traffic conditions	Controlled delay (sec/veh)
A	No delays on stop controlled approached	<10
B	Operation with minor delay	>10 -- ≤15
C	Operations with average delay	>15 -- ≤25
D	Operations with high delay	>25 -- ≤35
E	Operation with very long delays	>35 -- ≤50
F	Operation with extreme congestion, with very high delays and long queues unacceptable to most drivers	>50

Source: Highway Capacity Manual, Transportation Research Board, 2000

RESULTS: ACCESS ROAD INTERSECTION 1

Traffic generated during the construction phase is anticipated to be limited as primarily vehicles delivering materials will be entering and exiting the development. Overall, traffic during construction will not significantly affect the delay waiting time or Level of Service experienced by motorists travelling along the A1 Highway as they have a Level of Service of "A" for both lanes of travel during construction. However, traffic entering and exiting the development will have a Level of Service of "B" (Table 8-13, Figure 8-8). It is expected that heavy units entering and leaving the construction site will have moderate waiting times. The impact on the highway through traffic is not noticeable.

Table 8-13 The Movement Performance at Access Road 1 Intersection for the Evening Hour Scenario, During Construction

Movement Performance - Access Road 1 Intersection												
Mov	Turn	Demand Flows		Deg.	Average	Level of	95% Back of Queue		Prop.	Effective	Aver. No.	Average
ID		Total	HV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Cycles	Speed
		veh/h	%	v/c	sec		veh	m				km/h
North-East: Major Road-Lucea Side												
11	T1	273	12	0.171	**0.2**	**LOS A**	0.3	1.9	0.1	0.06	0.1	59
12	R2	27	3.8	0.171	**6.9**	**LOS A**	0.3	1.9	0.1	0.06	0.1	56.8
Approach		300	11.2	0.171	**0.8**	**NA**	0.3	1.9	0.1	0.06	0.1	58.8
North-West: Princess Hotel Access Road 1												
1	L2	15	7.1	0.047	**9.8**	**LOS A**	0.2	1.3	0.47	0.91	0.47	50
3	R2	16	13.3	0.047	**12.9**	**LOS B**	0.2	1.3	0.47	0.91	0.47	49.3
Approach		31	10.3	0.047	**11.4**	**LOS B**	0.2	1.3	0.47	0.91	0.47	49.6
South-West: Major Road - Negril Side												
4	L2	28	7.4	0.174	**5.6**	**LOS A**	0	0	0	0.05	0	57.6

Movement Performance - Access Road 1 Intersection												
Mov	Turn	Demand Flows		Deg.	Average	Level of	95% Back of Queue		Prop.	Effective	Aver. No.	Average
ID		Total	HV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Cycles	Speed
		veh/h	%	v/c	sec		veh	m				km/h
5	T1	283	14.9	0.174	**0**	**LOS A**	0	0	0	0.05	0	59.4
Approach		312	14.2	0.174	**0.5**	**NA**	0	0	0	0.05	0	59.3
All Vehicles		642	12.6	0.174	1.2	NA	0.3	1.9	0.07	0.1	0.07	58.5

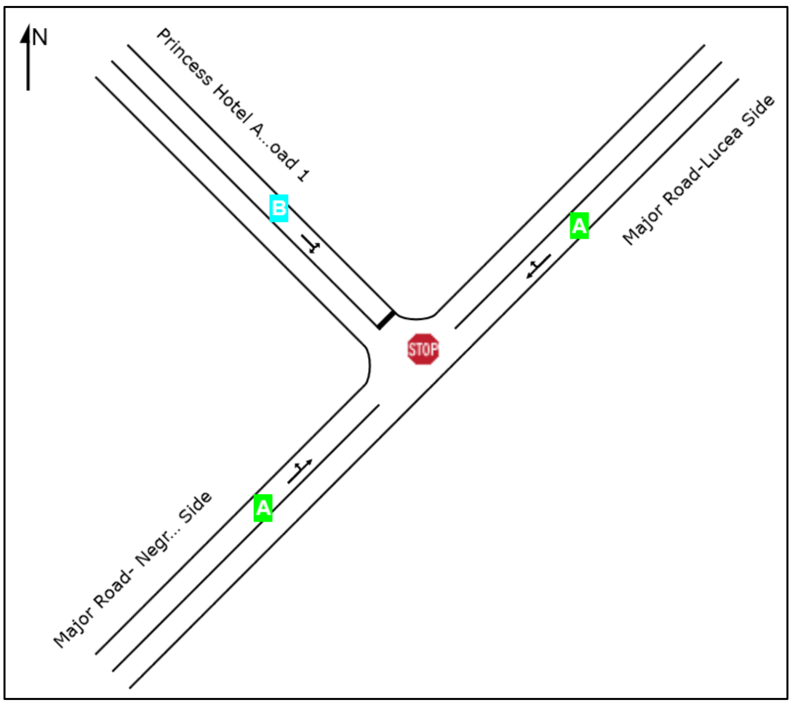


Figure 8-8 LOS at Access Road Intersection 1 (during construction)

RESULTS: ACCESS ROAD INTERSECTION 2

As with Intersection 1, traffic during the construction will not significantly affect the delay waiting time or Level of Service experienced by motorists travelling along the A1 Highway. These motorists will also have a Level of Service of "A" for both lanes. Traffic entering and exiting the development will also have a Level of Service of "B" (Table 8-14, Figure 8-9). It is expected that heavy units entering and leaving the construction site will have moderate waiting times.

Table 8-14 The Movement Performance at Access Road 2 Intersection for the Evening Hour Scenario, During Construction

Movement Performance - Access Road 2 Intersection											
Mov	Turn	Demand Flows		Deg.	Average	Level of	95% Back of Queue		Prop.	Effective	Average
ID		Total	HV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		Veh/h	%	v/c	sec		Veh	m			km/h
North - East: Major Road - Lucea Side											
11	T1	273	12	0.167	**0.2**	**LOS A**	0.2	1.6	0.08	0.05	59.2
12	R2	22	4.8	0.167	**6.9**	**LOS A**	0.2	1.6	0.08	0.05	56.9
Approach		295	11.4	0.167	**0.7**	**NA**	0.2	1.6	0.08	0.05	59
North - West: Princess Hotel Access Road 2											
1	L2	12	9.1	0.038	**9.9**	**LOS A**	0.1	1	0.47	0.91	49.9
3	R2	13	16.7	0.038	**13**	**LOS B**	0.1	1	0.47	0.91	49.1
Approach		24	13	0.038	**11.5**	**LOS B**	0.1	1	0.47	0.91	49.5
South - West: Major Road - Negril Side											
4	L2	23	9.1	0.171	**5.7**	**LOS A**	0	0	0	0.04	57.6
5	T1	283	14.9	0.171	**0**	**LOS A**	0	0	0	0.04	59.5
Approach		306	14.4	0.171	**0.4**	**NA**	0	0	0	0.04	59.4
All Vehicles		625	13	0.171	1	NA	0.2	1.6	0.06	0.08	58.8

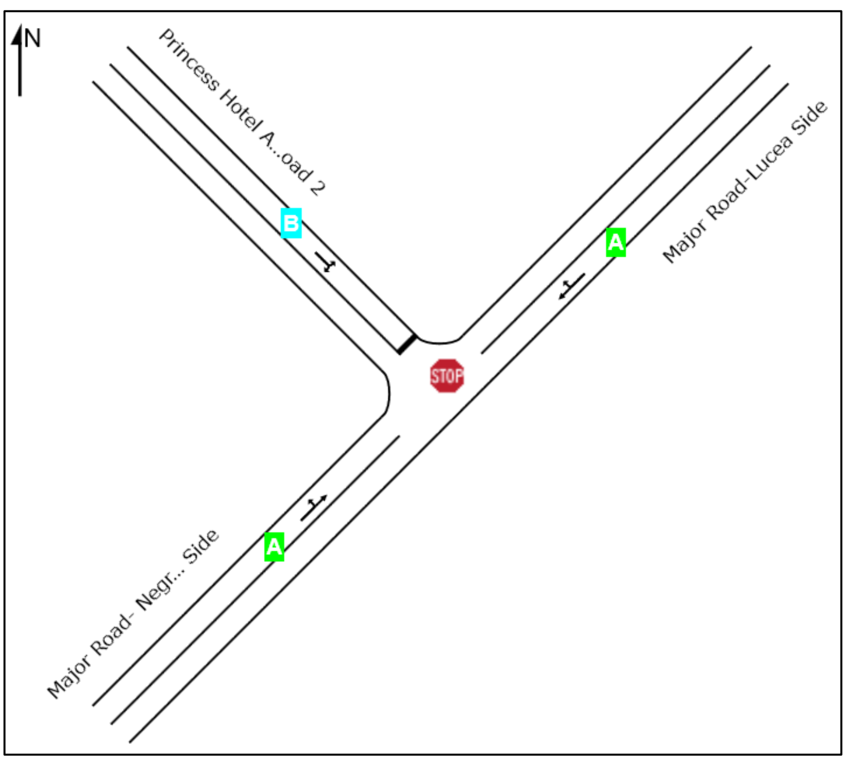


Figure 8-9 LOS at Access Road Intersection 2 (during construction)

SUMMARY

From the analysis, traffic travelling along the through lanes to Negril and Lucea are not significantly affected during the construction phases. Vehicles entering and exiting the hotel property are expected to experience tolerable delays for short periods (Table 8-15 and Table 8-16).

Table 8-15 Summary of Access Road 1 Intersection Scenarios during construction

Access Road 1 Intersection	North-East: Major Road-Lucea Side				South-West: Major Road- Negril Side				North-West: Princess Hotel Access Road 1			
	Through		Right		Left		Through		Left		Right	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Existing	0.4	A	6.7	A	5.8	A	0	A	10.8	B	14.9	B
Construction Phase	0.2	A	6.9	A	5.6	A	0	A	9.8	A	12.9	B

Table 8-16 Summary of Access Road 2 Intersection Scenarios during construction

Access Road 2 Intersection	North-East: Major Road-Lucea Side				South-West: Major Road- Negril Side				North-West: Princess Hotel Access Road 2			
	Through		Right		Left		Through		Left		Right	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Existing	0.4	A	6.6	A	5.8	A	0	A	10.8	B	14.5	B
Construction Phase	0.2	A	6.9	A	5.7	A	0	A	9.9	A	13	B

RECOMMENDED MITIGATION

None required.

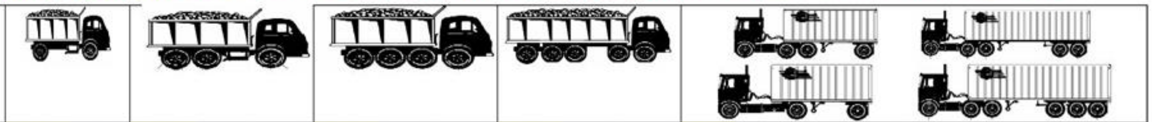
Road Surface – Overweight Vehicles

All trucks are expected to adhere to the NWA standard for the loads per axel they exert on the pavement, otherwise severe deterioration to the road may result. Large units including tankers, and trucks carrying building and operation machine parts will pose challenges because of their sizes and weight. Special permits will be requested from the NWA as required two weeks in advance. Further, overloaded vehicles are harder to control and more unstable and difficult to stop in an emergency.

RECOMMENDED MITIGATION

In order to alleviate road damages, all the weight of trucks carrying construction materials must be determined by scale and overloading is strictly prohibited (Figure 8-10).

SPECIAL PERMIT REQUIREMENTS vehicles exceeding Permit Column data can be issued ith a Special Permit once the vehicle does not exceed the relevant column etc



Maximum Allowable	Permit	MAX Limit	Permit	MAX Limit	MAX Limit	Permit	MAX Limit	MAX Limit	Permit	MAX Limit	MAX Limit	Permit	MAX Limit	MAX Limit	MAX Limit	MAX Limit	MAX Limit	MAX Limit	MAX Limit
Overall Height (m)	3.6	4.15	3.6	4.15	4.15	3.6	4.15	4.15	3.6	4.15	4.15	3.6	4.15	4.15	4.15	4.15	4.15	4.15	4.15
Gross Weight (tons)	12.2	15	12.2	20	25	12.2	30	35	12.2	30	35	12.2	25	30	35	40	45	50	55
Length (m)	9.14	12.8	9.14	12.8	12.8	9.14	12.8	12.8	9.14	12.8	12.8	12.8	17.3	17.3	17.3	17.3	17.3	17.3	17.3
Width (m)	2.44	2.70	2.44	2.70	2.70	2.44	2.75	2.75	2.44	2.75	2.75	2.44	2.75	2.75	2.75	2.75	2.75	2.75	2.75
No. of Axles	2	2	3	3	3	4	4	4	5	5	5	3	3	4	4	5	5	6	6
No. of Tires	6	6	8	8	10	12	12	14	16	16	12	10	10	12	14	16	18	20	22

Please note that

1. Maximum allowable dual tire axle load is **10 tonnes** except super singles/ flotation
2. Maximum allowable single tire axle load is **5 tonnes** except super singles/ flotation
3. maximum allowances **must not exceed manufacturer ratings**, specifications for **vehicles and tires** etc
4. Special permits are required for tucks that exceed one or more of the following criteria:

    a. ***Overall Length of 9.14m (rigid) or 12.8 m (articulated/trailer)***
    b. ***Overall width of 2.44 m,***
    c. ***Gross weight of 12,273 kg,***
    d. ***overhang of 50% of wheelbase,***
    e. ***height of 3.6 m from ground***

Figure 8-10 NWA weight limit requirements for heavy vehicles

Traffic Management

The sequence of construction is expected to adhere to the basic outline as shown:

1. Site Clearance
2. Construction of:
    a. Perimeter fencing
    b. Coastal works
    c. Buildings and civil
    d. Roads
    e. Tanks
3. Installation of Special Machinery and equipment

These general stages in the sequence will generate similar types of traffic on the roads. The trips generated will have a much higher percentage of heavy vehicles. This is because there will be delivery of materials and equipment to the site as well as removal of solid waste or debris from the site. Special machinery installation may in some cases involve large units to transport these cases and will require NWA permitting and most likely scheduled for late nights.

Construction traffic will be mostly trucks delivering materials to the site as well as removing rubbish. This will vary somewhat for the different stages of construction, for example site clearance will have predominantly rubbish removal from site whereas infrastructure construction will have trucks delivering to site. Based on experience from construction of similar resorts, it is expected that the number of trips per day does not exceed 50 during any of the phases.

RECOMMENDED MITIGATION

The following mitigation measures will be implemented to minimize traffic:

- Construction traffic entering or leaving the site will be scheduled for off peak hours to minimize additional congestion at the intersections and/or disruptions in the regular traffic flow.
- Construction next to the highway will be scheduled for off peak hours and adequate traffic management procedures/methods will be put in place.
- Adequate covering up of the works to minimize danger to passing traffic.
- Erection of signs ahead of the works warning motorists of the construction ahead.

Road Safety

Approximately 50m south of Access Road 1, where the Glasgow intersection is located, is a known accident hotspot. This is due to mainly due to observed speeding along the corridor, even with speed zoning in the area posted as 50km/h.

RECOMMENDED MITIGATION

Increased signage in the area to remind motorists to reduce their speed as they approach each intersection.

8.2.3.6 Health and Safety

Construction activities have the potential for accidental injury, whether major or minor. For example, construction works may entail workers being suspended in the process and this has the potential for increased construction accidents. Fugitive dust has the potential to affect the health of construction workers.

Recommended Mitigation

i. The provision of lifelines, personal safety nets or safety belts and scaffolding for the construction workers (if necessary)
ii. Ensuring that workers wear personal protective equipment (hard hats, reflective vests, safety shoes, eye protection etc.)
iii. Where unavoidable, construction workers working in dusty areas should be provided and fitted with N95 respirators.
iv. Areas should be dampened every 4-6 hours or within reason to prevent a dust nuisance and on hotter days, this frequency should be increased.
v. There should be onsite first aid kits and arrangement for a local nurse and/or doctor to be on call for the construction site.

vi. Make prior arrangements with local health care facilities such as health centres or the Noel Holmes Hospital in Lucea to accommodate any eventualities
vii. Make prior arrangements with the Lucea Fire Station and Green Island Police Station to accommodate any eventualities.
viii. Material Safety Data Sheets (MSDS) should be stored onsite.
ix. A lead person should be identified and appointed to be responsible for emergencies occurring on the site. This person should be clearly identified to the construction workers.
x. Trench Excavation
    - A trench 1.2m or more in depth must have a means of egress (ladders/ stairways/ramps) and should be located at 8m intervals.
    - Excavated materials must be stored 0.6m or more from the open trench (not to be measured from the crown of the spoil).
    - Spoil should be placed so that the channels rainwater and other runoff water away from the excavation.
    - Take precautions regarding Tension Cracks
        - Tension cracks usually form at a horizontal distance of 0.5 to 0.75 times the depth of the trench.
        - Sliding or sloughing may occur as a result of tension cracks. [10]

8.2.3.7 Aesthetics

Construction activities may decrease the aesthetic appeal of the area; however, this will be for a short-term period during construction. In particular, trucks leaving the construction site have the potential to deposit marl and mud onto the main road, making the main road aesthetically unappealing and in the process, affecting the conditions of other vehicles traversing the main road.

Recommended Mitigation

- Good housekeeping activities and adherence to other mitigative measures.
- An area of gravel should be placed on site (just before exiting onto the main road) to help remove mud/marl from truck wheels.
- A wheel wash area on site (just before exiting onto the main road) should be implemented to rid wheels of as much mud/marl as possible

8.2.3.8 Historical Artefacts

No historical, archaeological features were uncovered. No artefacts were recovered.

Recommended Mitigation

None

[10] Worker Health and Safety Guidelines as per OSHA #510 Construction Industry Standard 29 CFR Part 1926.

8.3 OPERATION

8.3.1 Physical

8.3.1.1 Drainage and Hydrology

Smith Warner International Limited conducted a detailed drainage design plan for the proposed project. The following section summarizes the main findings from the associated report regarding post-development drainage conditions.

The detailed **"Master Drainage Plan Design Report"** is submitted as a standalone report document.

Mangrove Usage and Improvements

The drainage concept will aim to follow the existing site conditions. The relatively low-lying flat site gently slopes from elevations ranging from 2.5m to 0.5m above mean sea level (MSL) down towards the mangrove forest, which lies around 0 to 0.2m MSL. This wetland is also located downstream of a wider catchment area that drains into it. Hence, the mangrove forest acts as a natural retention system during low flows, storing runoff to nourish the flora within it.

The proposed site drainage follows the natural flow path and drains freely into the mangrove which increases the projected flood elevation in the mangrove as shown in Table 8-17. The flood elevation will be increased by 40mm for a 100-year storm event if all storm water runoff from the proposed site is discharged into the mangrove. The 100-year floodplain was delineated along the 0.9m MSL contour line within the mangrove and a 30m buffer was established as per *Section 1.6.4 of the NWA-2015* document. From this, it can be deemed that the increased flood elevation of 40mm for a 100-year event has negligible impacts to adjacent communities.

To account for climate change, the peak 24hr rainfall was increased by 17.87% as per the projections. Additionally, recognizing that climate change will affect other variables that influence rainfall (i.e. intensity and duration), the site was designed to withstand return periods that are greater than industry standards.

Table 8-17 Flood levels within mangrove forest

Projected water level within mangrove (m MSL) (17.87% increase in rainfall due to climate change)			
Storm Event	**Pre-developed**	**Post-Developed**	**Difference**
2yr	0.35	0.375	0.025
5yr	0.49	0.532	0.042
10yr	0.573	0.607	0.034
25yr	0.62	0.656	0.036
50yr	0.747	0.795	0.048
100yr	0.836	0.876	0.040

Enhancement to the mangrove system is proposed by introducing several culvert openings throughout the existing road network within the mangrove. This would promote more free movement of water through the entire mangrove forest, which will improve the storage capacity and provide water to areas currently deprived of water.

Several ponds are proposed within the barren elevated areas in the midst of the mangrove to alleviate any flooding impact on adjacent communities. Such elevated areas would be excavated to 0m MSL to increase the storage capacity of the mangrove and encourage expansion of the mangrove's flora. The Master Plan shows the location and extents of these ponds while Table 8-18 below shows the additional volume provided and the respective decrease in projected flood elevations. These ponds add volume capacity to the storage capabilities of the mangrove and increase the square area of effective mangrove.

Table 8-18 Increase in storage capacity and mangrove area from proposed ponds

Pond	*Increase in Storage Capacity (m^3)*	*Increase in Mangrove Area (m^2)*
Pond 1	7,066	12,602
Pond 2	7,978	16,933
Pond 3	1,149	3,413
Total	**16,193**	**32,948**

Site Drainage Concept

The proposed drainage concept will allow rainfall runoff to drain freely into the mangrove via ten outfall points. All the outfall points were set at an elevation higher than the projected flood elevation for the 1 in 50-yr storm frequency, with consideration for climate change. The use of multiple outfall points proved advantageous as it works better for a flat site and reduces the amount of grading required while resulting in smaller drain sizes. These drainage outfalls will be controlled by hydraulic structures consisting of outfall pipes with flap gates to prevent back flow of water into the site when water levels in the mangrove exceeds the 50-year design flood level within the forest. These outfall pipes will be encased within a catch pit that contains a 500mm deep sump strategically located to trap sediments prior to discharging into the mangrove.

All other internal drains will be primarily buried pipes and covered box drain with catch pits to keep in accordance with the architect's finish concept. All such drains and outfall pipes were designed for a 1 in 25-year storm frequency.

Hydraulic Performance of Proposed Drainage Plan

As per best storm water management practices, all drainage systems are design for a particular storm frequency, striking a balance between flood risks and project cost. All drainage systems will flood as it is uneconomical and against industry practice to design for the “worst case” scenario. As such, the proposed drainage plan for this site was designed using a 1 in 25-year storm frequency and the site was set above the expected 1 in 50-year flood elevation. Table 8-19 below summarizes the hydraulic performance of the drainage system under various design storm frequencies.

Table 8-19 Summary of Hydraulic Performance of the proposed drainage system

STORM FREQUENCY	ANNUAL EXCEEDANCE PROBABILITY	HYDRAULIC PERFORMANCE	
		Site Drainage	Mangrove
1 in 2 year	50%	Site drains will perform good allowing rainfall runoff to drain freely into the mangrove.	Max. water level is expected to be 0.375m MSL which is below design outfall points. This is approx. 75mm above natural outfall elevations of the mangrove
1 in 5 year	20%	Site drains will perform good allowing rainfall runoff to drain freely into the mangrove.	Max. water level is expected to be 0.532m MSL which is below design elevations of the outfall points
1 in 10 year	10%	Site drains will perform good allowing rainfall runoff to drain freely into the mangrove.	Max. water level is expected to be 0.607m MSL which is below the design elevations of the outfall points
1 in 25 year	4%	Site drains will perform good allowing rainfall runoff to drain freely into the mangrove.	Max. water level is expected to be 0.656m MSL which is below the design elevations of the outfall points
1 in 50 year	2%	Site drainage is expected to experience "flash flooding" as the internal drains were designed for a 1:25yr hydraulic capacity. The freeboard in each drain will absorb some of the excess flow. Since the outfall points are set higher than the projected water elevation in the mangrove for this storm frequency, the site water will be able to drain freely into the mangrove. Hence, the flood time within the site will be minimal.	Max. water level is expected to be 0.795m MSL which is below the design elevations of the outfall points
1 in 100 year	1%	Site is expected to flood as the rainfall intensities exceed that which the drains were designed for (1:25yr intensity). It is expected that there will be zero outflow from the site for some time when the projected water levels in the mangrove goes beyond the 0.8m MSL design outfall elevation. At these elevations the flap gates connected to the outfall pipes will close. Water from the site will then outfall through said outfalls once the flood elevations in the mangrove drops below 0.8m MSL	Max. water level is expected to be 0.876m MSL which is above the design elevations of the outfall points. This will result in the flap gates on the outfall pipes to be closed for some time, preventing flood waters from the mangrove to backflow onto the site.

8.3.1.2 Currents

The swell wave events of March 1 – 10, 2009 were used to assess the coastal structures' performance under swell conditions.

Operational current conditions at the peak of a swell event in Figure 8-11 and Figure 8-12 show a dominant westerly movement. In a swell event the wave-driven currents increase to above 0.88 m/s in some sections of the rocky shoreline. Currents along the bay of Hotel 1 are still very small (i.e. below 0.16 m/s). The introduction of the flushing channel does not significantly change the currents. Currents along the site did not change significantly. Slow currents are created within the channel.

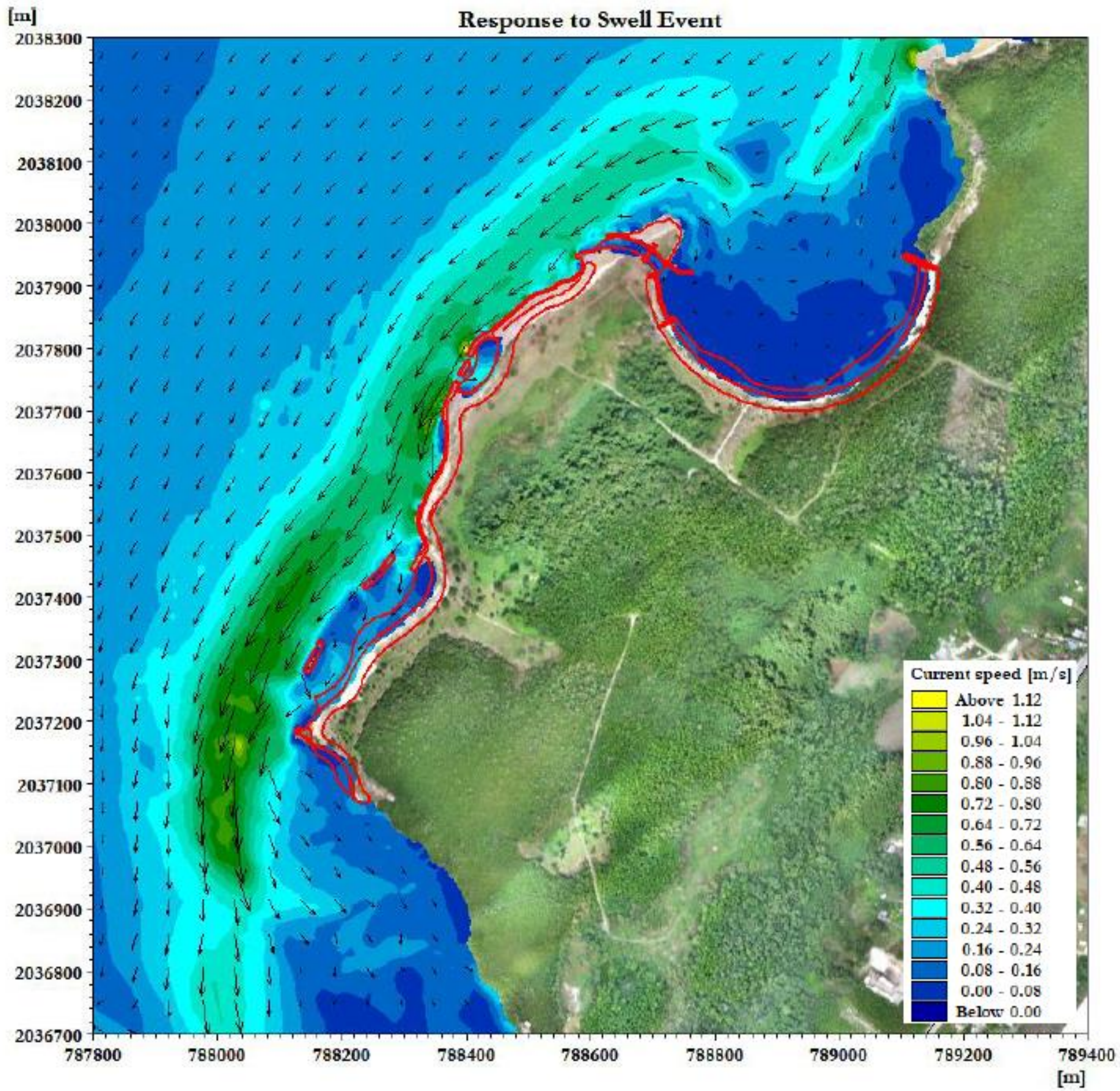


Figure 8-11 Operational Current speeds at the peak of a swell event

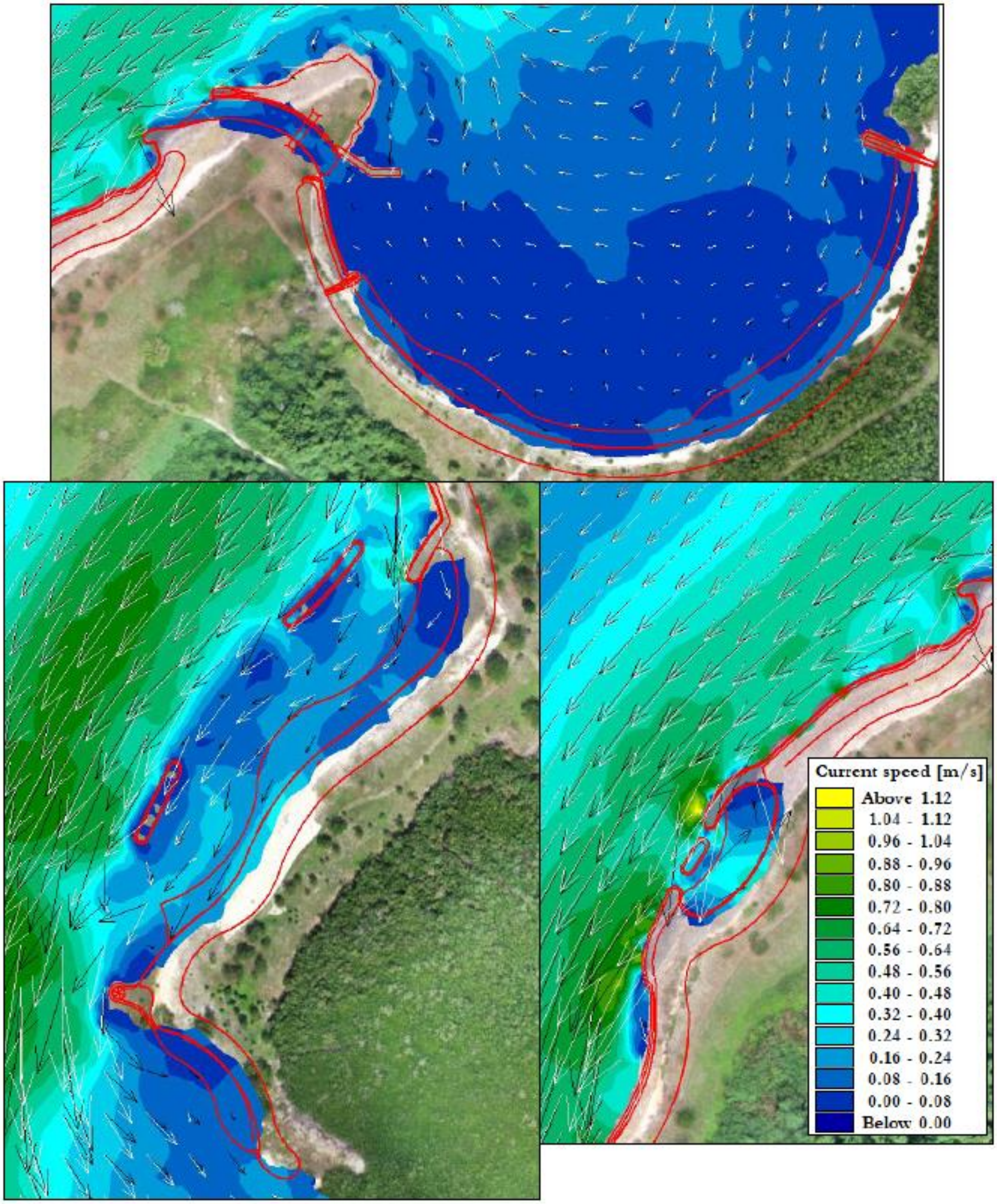


Figure 8-12 Operational current speeds at the peak of the swell event (White arrows: pre-development; Black arrows: post-development)

Flushing Response

The flushing of the area was assessed by introducing a theoretical pollutant into the bay. This pollutant could be an oil spill, sewage, high nutrients from run off, etc. In high concentration, these contaminants can make the beach experience uncomfortable. Our investigation found that under pre-development conditions, a high percentage (over 40%) of a pollutant would remain in the area after 24 hours. International guidelines for an area such as a marina suggest that pollutants should be below 5% in less than one day. It would take almost 3.5 days for this bay to get below the 5% concentration. The results show the contaminant would tend to gather at the east end of the bay and would create unfavourable bathing conditions (Figure 8-13). The pollutant also accumulates beside the existing groyne and the groyne was therefore removed to model post-development This confirms our initial observations of an accumulation of debris in this area.

We modelled the flushing with the proposed post-development concept in place. Results showed that strong currents on the west help to draw out the pollutant and reduce the concentration. The use of the flushing channel is critical in improving the flushing of the area. Additionally, the flushing assessment showed that the removal of existing groynes is very important. With the flushing channel in place the pollutant concentration is reduced to less than 5% in just under 1.5 days (Figure 8-14). This is a significant improvement (more than two times more efficient) to the pre-development situation. To reduce the flushing time even further, the breakwaters were removed from the system. The results showed that the breakwater removal did not affect the morphology of the system. The increased circulation would also balance the pH and salinity of the bay and promote healthier marine life.

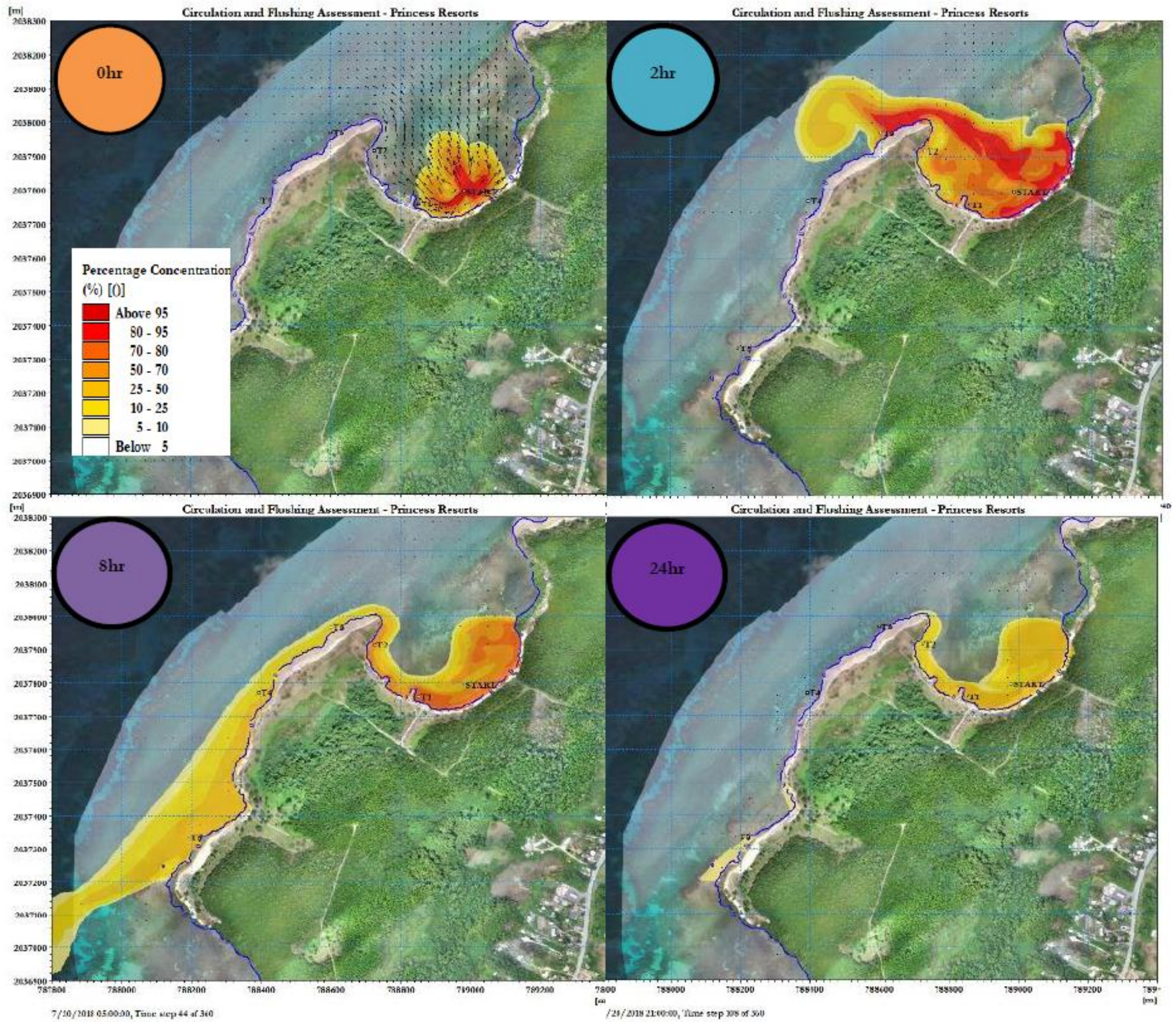


Figure 8-13 Flushing conditions up to 24 hours after introduced pollutant for pre-development scenario

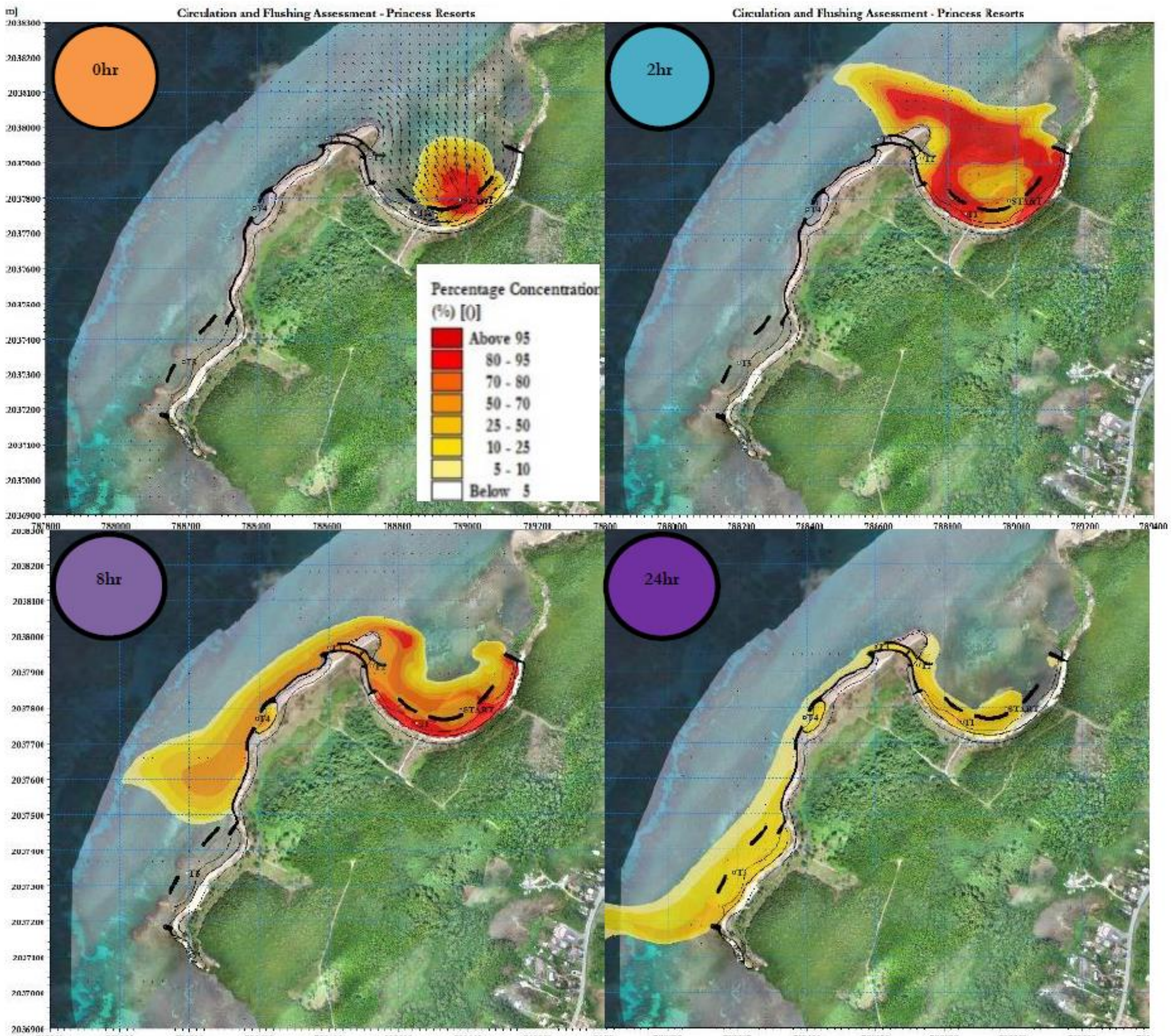


Figure 8-14 Flushing conditions up to 24 hours after introduced pollutant for post-development scenario

8.3.1.3 Ocean Sediment Transport

The swell wave events of March 1 – 10, 2009 were used to assess the coastal structures' performance under swell conditions.

Sediment movement at the peak of a swell event for pre- and post- construction scenarios is shown in Figure 8-15. The flow of sediment follows the flow of currents in the area. The plot shows the total load, which refers to the volume of sediment moving at a given time. For instance, $100m^3/s/m$ represents a total of $8.64m^3$ of sediment moving in a day. This can be visualized as approximately half a load in a standard truck.

As the current direction and magnitude did not change significantly, the sediment transport remained almost unchanged.

Downdrift Changes to Shoreline

Downdrift changes to adjacent shorelines are not expected to occur with the implementation of the works. Sediment flow in the area is predominantly to the west and the proposed groyne and breakwaters are well outside of the major transport zones. As seen in Section 6.1.10, the bulk of sediment transport at Hotel 1 occurs within the first 20m offshore while for Hotels 2 and 3 the bulk of transport occurs approximately 70m offshore. The proposed groynes will end 15m and 35m from the shoreline which is before the peak of the transport occurs. Additionally, potential sediment transport caused by a swell event remained relatively unchanged with the structures in place compared to the pre-development condition. Therefore, there is no significant impact expected to occur for downdrift shorelines (i.e. to the east).

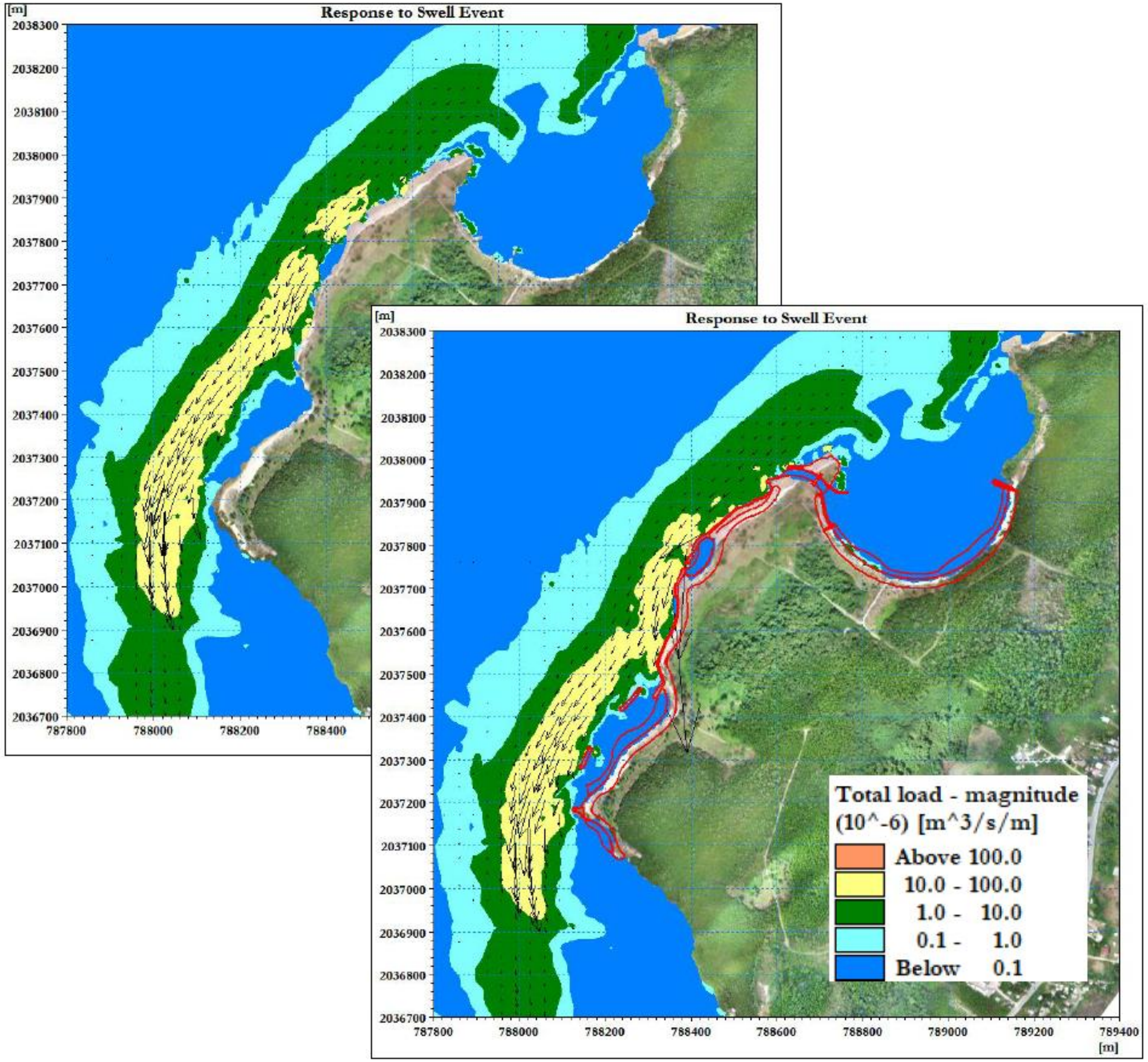


Figure 8-15 Total Suspended Sediment transport in pre-development (top) and post-development (bottom) scenarios during peak swell conditions

8.3.2 Biological

8.3.2.1 Vegetation

Introduction of invasive alien plant species via landscaping activities can result in their proliferation.

Mitigation

Ensure that plants used for landscaping are native/local species. Exotic/unknown plant species should not be used in landscaping.

8.3.2.2 Avifauna

Certain species may be impacted by large groups, noise or lighting during their breeding, nesting and brooding periods. It may be necessary to limit or regulate the number of individuals, lighting and other features if necessary.

8.3.2.3 Reef and Seagrass Communities

Reef and Seagrass communities, corals and other sessile organisms which live near to the impact area (sponges, gorgonians, tube worms, fanworms) should return to normal conditions.

Seagrass beds found directly beneath the searooms will be shaded at times throughout the daytime. Some seagrasses may tolerate a certain amount of shading as they are adapted to turbid, lower light conditions. Too much shading may result in the deterioration of the seagrass health and functionality and even loss of species and eventually habitat.

Hard structures (groynes, jetty, breakwaters) on the seafloor will provide some ecological volume for coral growth. Hard structures will provide substrate for coral recruitment and colonization which should change in composition over time.

8.3.2.4 Fish and Filter feeders

Fish may benefit from the additional hard structures (groynes, jetty, breakwaters). These will act FADs (Fish Aggregation Devices). This area may also be more managed and as a result the fish may benefit from some protection from overfishing. Filter feeders should see normal conditions return over time.

8.3.2.5 Sea Turtles

Turtles should see somewhat normal conditions return over time. However, turtles may experience some habitat fragmentation and loss of food sources from any modification to the seagrass beds in the area. In addition, the hard structures act as permanent obstacles which may deter turtles from returning to nest on the beach. Increased noise and lighting may affect and deter turtles from nesting.

Mitigation

Artificial lighting should not be placed on the beach. If lights have to be used, turtle-friendly lighting and light positioning (if any) should be used. Hotel operators should also educate their guests on sea turtle conservation and the correct actions to take if a sea turtle is observed nesting on the beach.

The Hotel will also develop a Sea Turtle Monitoring programme which would include tagging and hatchling release.

8.3.3 Natural Hazards

8.3.3.1 Swell Wave Climate

The swell wave events of March 1 – 10, 2009 were used to assess the coastal structures' performance under swell conditions.

Figure 8-16 shows wave conditions at the site at the peak of a swell event. The depth-limited bay of Hotel 1 had wave heights ranging from only 0.16-0.32m under a swell. In the location of the Sea Rooms the wave height is approximately 0.32m. Along the rocky shoreline the waves are still very large and get up to 1.44m. The addition of the breakwaters at Hotel 4 reduces the wave energy from 0.8m to maximum of approximately 0.32m.

Figure 8-17 shows a close-up of wave conditions at Hotel 1 (top) and Hotel 4 (bottom) at the site at the peak of a swell event. The yellow arrows show the magnitude (wave height) and the direction under proposed conditions, while the black represents existing conditions. For Hotel 1, these arrows are similar and represent no change in ambient conditions. For Hotel 4 the waves are smaller (shorter arrows). The change in arrow size only occurs in the vicinity of the structures.

At Hotel 1 without the breakwater in place, the wave climate remains relatively unchanged. Along Hotels 2 and 3, the swimming area created has wave heights less than 0.8m during the swell event, while the ambient wave conditions are greater than 1.7m. This represents an almost 50% reduction in wave energy. Along Hotel 4, the two breakwaters added to reinforce the reef reduce wave heights to 0.3m. These are small waves during swell conditions. Figure 8-17 shows wave directions in existing and proposed situations. The length of the arrows change direction and reduce in length. This shows that waves are reducing in height, and the arrows indicate potential for the formation of a salient. With this impact the nourishment shape is as shown to allow for the spreading out of sediment.

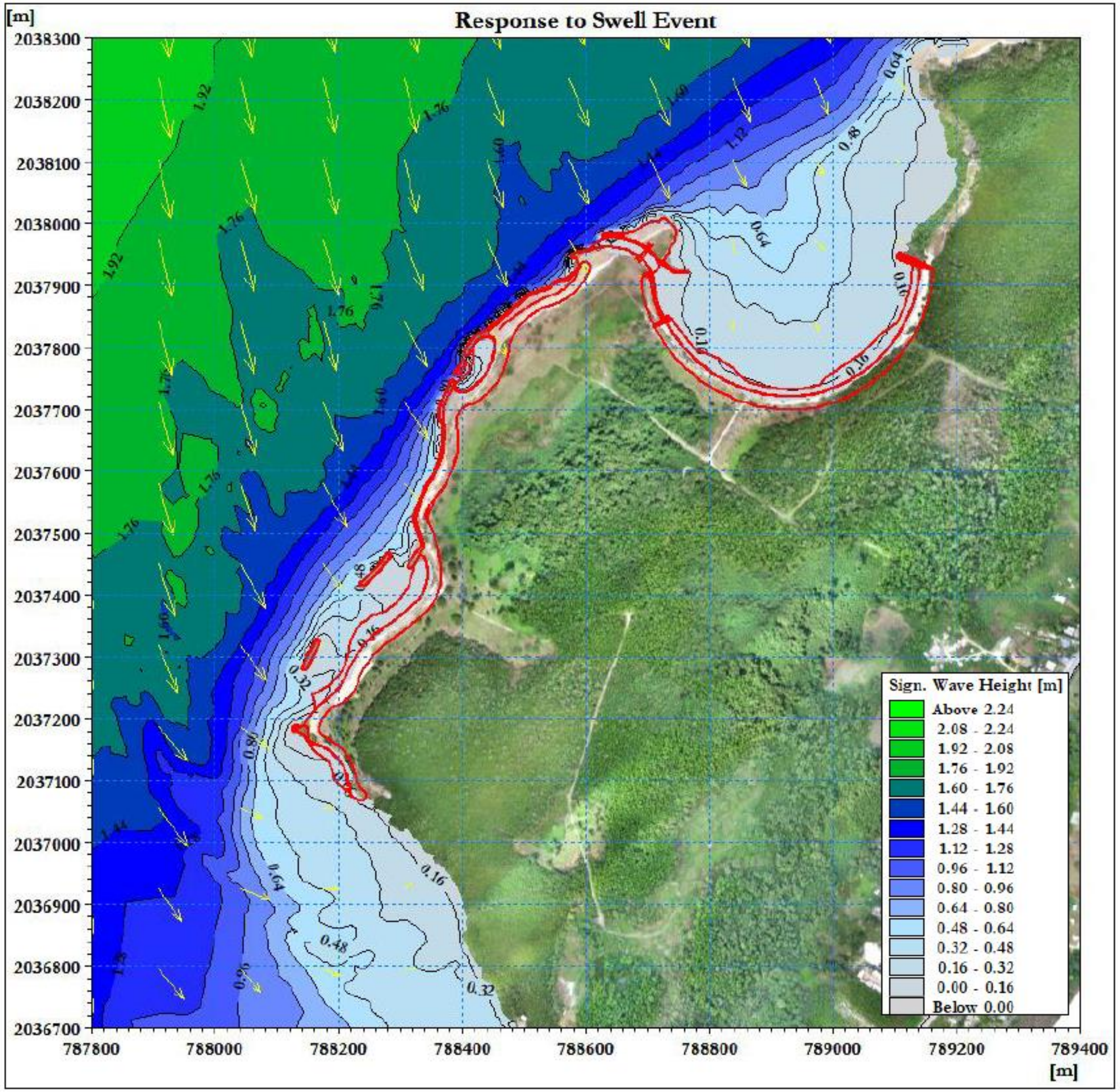


Figure 8-16 Concept response to swell waves

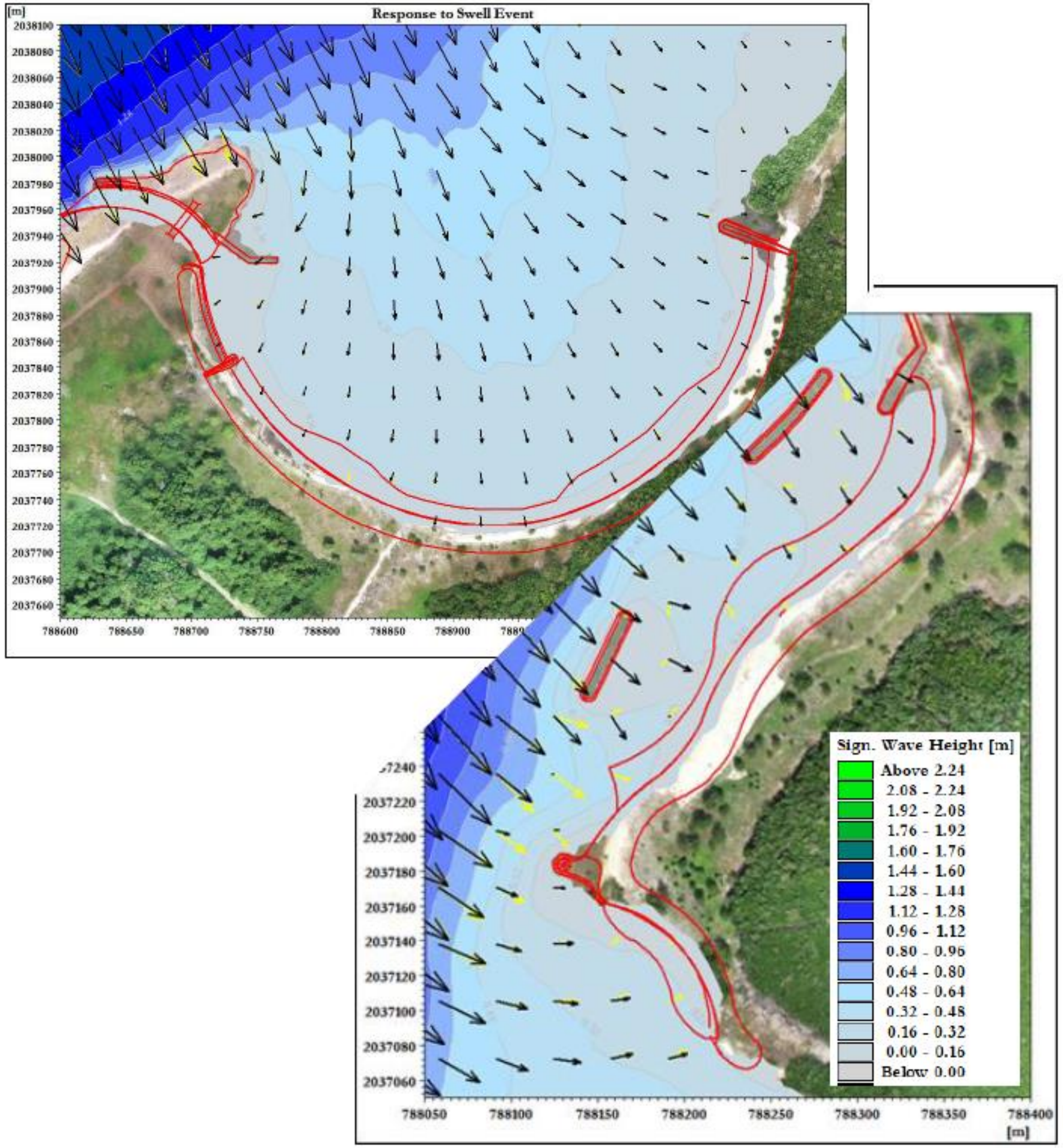


Figure 8-17 Close-up of Swell Wave response at Hotel 1 (top) and Hotel 4 (bottom) (Black arrows: Pre-development; Yellow arrows: Post-development)

8.3.3.2 Hurricane Waves and Storm Surge

Hurricanes have the potential to cause flooding from storm surge as well as damage due to high energy waves. Storm surge levels are related to the increase in sea level due to the low-pressure system caused by a hurricane. Under existing conditions, the site would be under more than 1.5m of water in the 50- year hurricane event. However, by increasing the ground level as recommended to facilitate drainage, the development is protected from hurricane-related flooding.

The site is a natural flood plain so unless the protection is extended, the overflow seen at the east and west ends of the property will continue. Such extensive protection is not necessary, however, as the proposed dyke road will keep the developed area safe and an elevated roadway from the resort to the North Coast Highway will manage excess during a storm.

The rocky shoreline of Hotels 2 and 3 is at the greatest risk to wave damage during a hurricane. The wave heights at this section of the development are greater than 2.5m. This has implications for the design of the revetment and groynes proposed for the area, as stronger waves will require larger structures to reduce the associated risks. The reef system at Hotel 4 reduces the wave heights that reach the shoreline at this section of the property. Reinforcing the reef with two breakwaters further reduces the height of waves reaching the proposed sandy beach area. Similarly, at Hotel 1, wave heights are reduced by the reefs to 1-1.5m. The lower wave energy in this area also promotes the use of honeycomb structures for the three proposed breakwaters, which promote marine habitat development. While the bay is somewhat sheltered, the stronger waves are toward its eastern end where the proposed Sea Rooms are to be located. Care must be given to the placement of the footprint of these buildings.

Figure 8-18 and Figure 8-19 show pre- and post-construction scenarios for the storm surge levels and significant wave heights respectively.

Recommended Mitigation – Floor Levels

Table 8-20 below shows the recommended minimum floor level heights of the hotels, to prevent flooding from storm surge.

Table 8-20 Recommended Minimum floor level heights for Hotel blocks

Hotel Block	Minimum Floor Level Heights
Hotel 1	+3.00 m MSL
Hotel 2	+3.65 m MSL
Hotel 3	+3.35 m MSL
Hotel 4	+3.25 m MSL

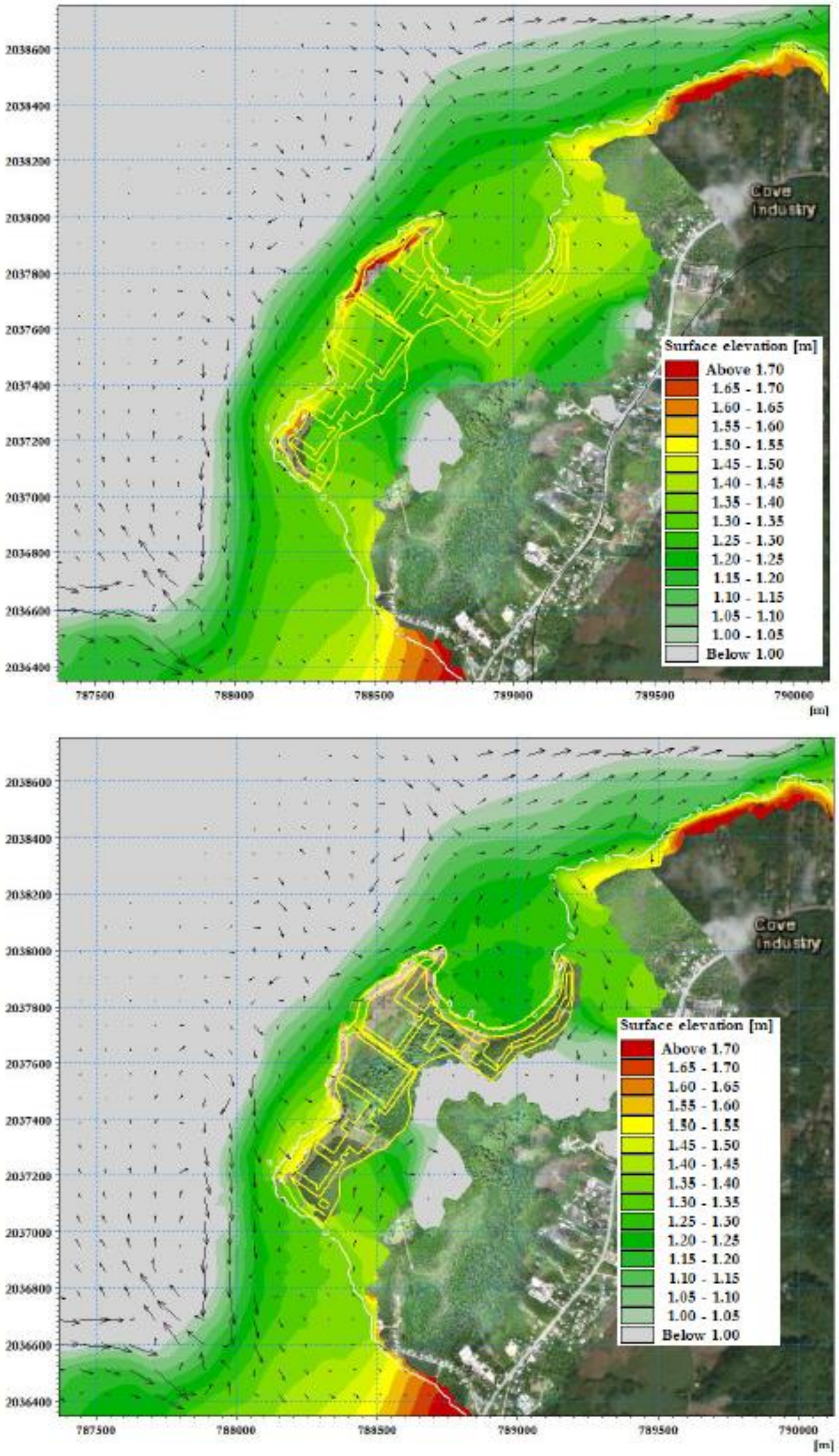


Figure 8-18 Static storm surge levels (1 in 50 year event) with no structures in place (top) and with structures in place (bottom)

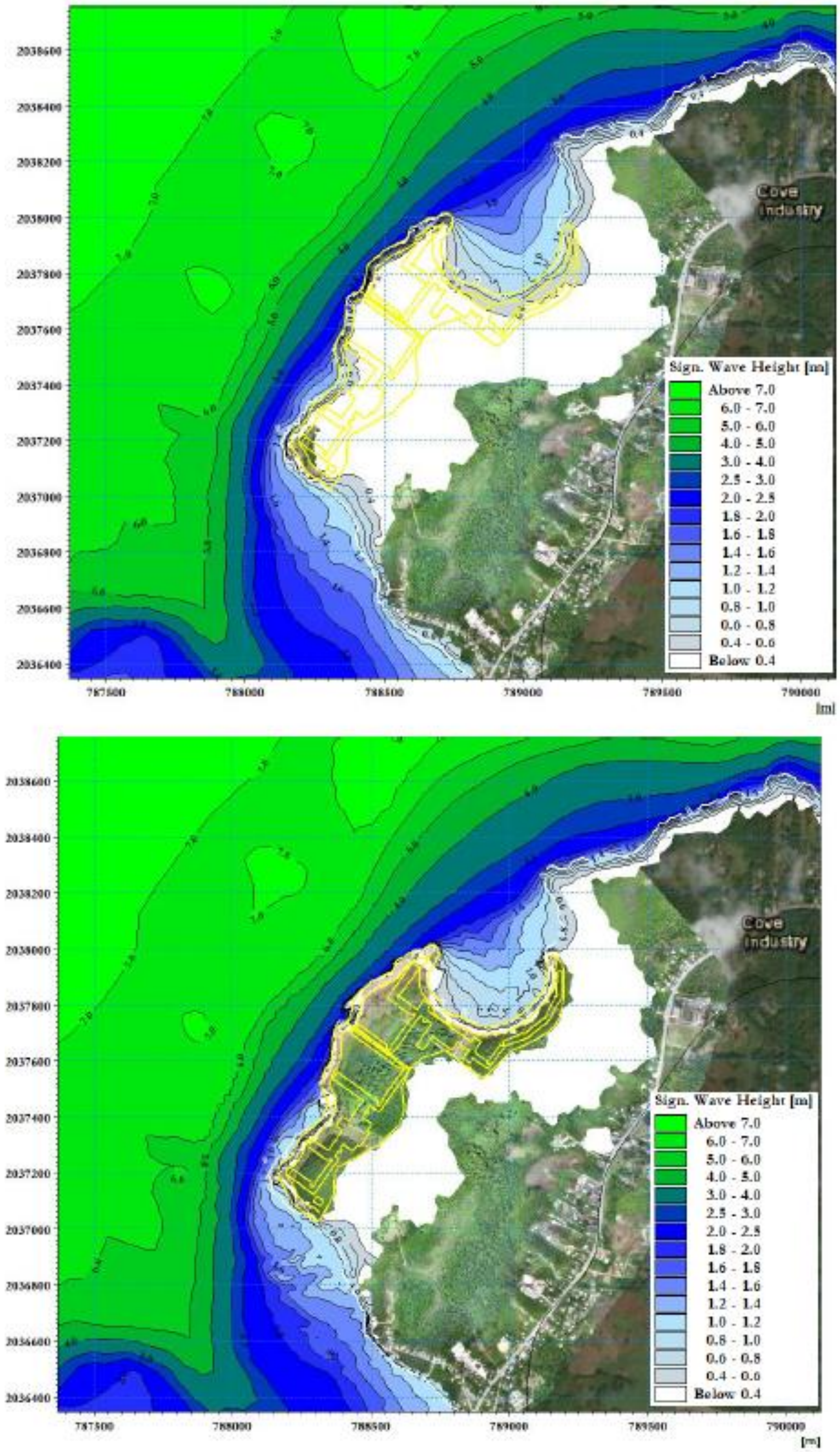


Figure 8-19 Significant wave heights (1 in 50 year event) with no structures in place (top) and with structures in place (bottom)

8.3.3.3 Climate Change Considerations

Climate change will impact the Princess Resort development in several ways. The coastline and drainage system will be particularly vulnerable. The *State of Jamaica Climate 2015* and the *Inter-Governmental Panel on Climate Change (IPCC) Summary for Policy Makers 2015* were referenced to consider the potential climate change impacts.

The associated risks and measures taken are discussed below.

INCREASED RAINFALL INTENSITY

Increase rainfall intensity during the rainy season could cause flooding of the property. Rainfall data were taken from the gauge closest to the Princess Resorts' site on the Jamaica 24-hr. Extreme Rainfall (mm) Isohyetal Maps for the various return periods. The impact of climate change was accounted for by using the projected changes in rainfall throughout Jamaica guided by the Climate Studies Group of Mona University of the West Indies in their 2017 publication of "*The State of the Jamaican Climate 2015*." Table 8-21 presents such changes for the western side (Zone 3) of Jamaica where the site is located.

The February-March-April ("FMA") season displayed the most significant increases in rainfall. Considering the design life of the drainage structures is typically 50 years as per ASCE 2005 engineering guidelines, the change within the entire timeline presented above should be considered. Hence, the mean value for the FMA season was calculated for the full timeline to be **17.87% increase** in peak rainfall. This percentage increase was used to project the peak rainfall used in the hydrologic analysis.

<u>Recommended Mitigation:</u>
Structures and buildings were designed for higher than standard return events, for example, NWA recommendation of the 1 in 25 yr was increased to 1 in 50 yr condition.

Table 8-21 Projected %Changes in Rainfall by Season for the Western Side of Jamaica (Table 49. Climate Study Group Mona U.W.I..2017)

SEASON (months)	**TIMELINE**							
	2020's		2030's		2050's		2080's	
NDJ	3.27	16.13	2.15	26.56	1.63	29.71	7.1	35.1
FMA	1.12	28.36	-5.89	28.23	16.12	39.86	-1.09	36.23
MJJ	4.21	17.09	-11.84	12.77	-8.54	17.59	-29.46	4.98
ASO	-12.9	7.01	-25.13	3.17	-20.92	4.13	-26.92	0.29

LONGER DRY PERIODS

Longer dry periods could cause more soil erosion leading to more siltation of the drainage systems. From the study of the site, it was recognized that the siltation would be a problem for the Negro Bay. Silt from the mangrove forest and land gets carried into the sea and therefore creates unfavourable conditions. With the impact of the climate change, the amount of siltation would increase and hence cause more problems for the coastal area.

Recommended Mitigation:
The drainage plans are fortified with silt traps to reduce the siltation impact to the coastal areas. The design also includes a flushing channel as discussed in Section 8.3.1.2. This flushing channel will work to increase the circulation of the area overtime. The increased circulation would balance the pH and salinity of the bay and promote healthier marine life.

SEA LEVEL RISE AND INCREASED WAVE ACTION

Sea level rise in the Caribbean Sea will cause more intense wave impact on a day to day basis and during hurricanes. Designing with climate change in mind presents some difficulties because most guidelines are projections that may change in the coming years. Guidelines have been summarized in the *Inter-Governmental Panel on Climate Change (IPCC) Summary for Policy Makers* publication. The main section that is applied for coastal work is the projection for mean global sea level rise. The IPCC RCP8.5 guideline was chosen as it represents the highest level of radioactive forcing by the year 2100. The global mean increase in sea level is projected to be 0.63m. Even with the anticipated increase in sea levels the site would not be flooded in 50-year storm event.

Table 8-22 below shows the water level increases for the return periods used for the designs.

Table 8-22 Calculation of water levels for 25, 50 and 20 – year hurricane return periods

Parameter	Return Period (years)			Notes
	25	50	100	
Inverse Barometric-Pressure Rise (IBR) (m)	0.26	0.32	0.37	Determined through statistical hind-casting analysis
Highest Astronomical Tide (m)	*0.25*			Determined through historical analysis
Rate of Sea Level Rise (mm/year)	*7.5*			RCP8.6 Scenario value from IPCC 2014 report (Edenhofer et al. 2015)
Design Time Horizon (years)	50			Design life of the structure
Design Deep Water Surface Level **without Climate Change (m)**	**0.51**	**0.56**	**0.62**	**Sum of IBR, Highest Astronomical Tide**
Design Deep Water Surface Level **with Climate Change (m)**	**0.70**	**0.94**	**1.37**	**Sum of IBR, Highest Astronomical Tide, and Sea Level for 50, 100 and 200 years.**

Recommended Mitigation:
The floor levels for the property were set to be above the 100-year storm surge events. This will ensure that the property remains protected under the rising sea levels. As illustrated previously in Figure 8-18, the site will be protected from the storm surge caused by a 1 in 50-year hurricane event.

STRUCTURAL FATIGUE FROM INCREASED STORM SURGE

To get the wave conditions offshore the site, HurWAVE program was used. HurWAVE is an internal program that uses a parametric hurricane model to calculate the offshore wave conditions for hurricane tracks. The program is continuously updated by the NOAA Best Track Data and currently has over 169 years of storm tracks. The program then performs the statistical assessment of the storms that come close the site and produces the wave heights for various return periods. Our numerical models (like MIKE21) were coupled with Sea Level Rise (SLR), factored windspeeds and wave heights to ascertain the impact of the climate processes on the nearshore conditions. The models have shown that higher SLR increases the wave conditions at the coastline. This increase is accounted for in the storm surge and coastal protection designs.

Recommended Mitigation:

All rock structures were also designed to withstand stronger waves that come from more intensive storms. The structures were given a **damage number (S_N)** of 1 which indicates that only one stone should be moved under design wave conditions per meter. This makes the structures more robust and allow minimal reshaping that reduces the likelihood of failure. Furthermore, rubble mound structures are selected due to their modular nature which makes them adaptable. Unlike other structures (like seawalls), rubble mound structures are easier to maintain and increased in size. If stones are displaced under more aggressive wave climates, the structures can easily be repaired and reshaped to accommodate for climate change.

8.3.4 Socioeconomic/Cultural

8.3.4.1 Employment

Once fully operational (Phase I and II), Princess Hotels and Resorts expects to employ approximately 2,852 persons (Phase I – 1,417 pers. and Phase II – 1,435 pers). The expected staffing for the operational phase of approximately 2,582 persons should result in approximately 4,763 indirect and 1,797 induced jobs. This has the potential to be a significant positive impact.

Persons engaged in this phase will require training, which will result in an increase of persons with training in the hospitality sector.

Mitigation

None required.

8.3.4.2 Water Supply and Consumption

Potable water for the development will be sourced from the National Water Commission (NWC). Water consumption is estimated to be 90,138.57m³/month (≈ 23,812,091 US gal/month). This equates to approximately 3,005 m³/day (≈ 800,000 US gal/day).

There is the potential for the hotel to further burden the water supply in the area in the event of drought conditions. In order to alleviate any potential burden on water supply in the area particularly during times of drought, it is recommended that various storage and conversation measures be put in place at the hotel such as:

- Low flow fixtures
- Dual flush toilets
- Faucets fitted with aerators
- Electronic spigots and flush valves

In addition to design and infrastructural measures for the reduction of water consumption, the hotel should also ensure operational measures are employed in order to manage the use of this resource. Summarized in Table 8-23 below is a list of recommended operational strategies for the reduction of water consumption:

Table 8-23 Operational strategies for reduced water consumption

Departments	*Operating Procedures*
Housekeeping	• Do not leave the tap running while cleaning, using buckets for holding water instead • Make sure that all faucets do not leak and are in good repair • Report immediately any leaking or dripping faucet or toilet • Give guests the option of changing linen and towels every two or three days • Use only the minimum required amount of detergent in the laundry • Reuse rinse-water in the first cycle of washing of the next load • Separate the laundry's hot-water system from the guest room hotel-water system if possible • Hotel guests can be given politely written cards as to how to conserve water in their bathrooms, for example to, shut off water during tooth brushing, shaving, and other unnecessary periods • Keep utility bills to track the consumption of water • Purchase and use water-saving equipment always • Establish an effective employee training program about water conservation
Food and Beverage	• Do not leave faucets running • Wash food products in buckets, bowls or containers • Use dishwasher with sufficient loads • Make regular inspections of dishwasher pumps for water leakage • Do not use water to defrost or thaw frozen food products, defrost in refrigerator • Report immediately any leaking and dripping faucet • Install infrared-activated faucets and toilets in restaurant rest rooms • Track the consumption of water by regular monitoring utility bills • Establish an effective employee training program about water conservation

Departments	*Operating Procedures*
Maintenance	• Recover waste pool water for reuse • Make regular inspections of circulating pumps for water leakage • Report immediately any pool or faucet leakage • Purchase and use water-saving pool equipment • Track the consumption of water by regular monitoring utility bills • Establish an effective employee-training program about pool water conservation • Consult pool specialists about effective maintenance of swimming pool

8.3.4.3 Solid Waste Generation and Disposal

The operation of the development has the potential of significantly increasing the solid waste at the site.

Mitigation

i. Provision of solid waste storage bins and skips.
ii. Provision of adequately designed bins and skips to prevent access by vermin.
iii. Monitor beach garbage.
iv. Contracting a private contractor to collect solid waste in a timely fashion to prevent a build-up.
v. Ensure that the solid waste collected is disposed in an approved disposal site - Retirement Disposal Facility, St. James.

8.3.4.4 Emergency Response

Impact

The operation of the proposed hotel will involve workers and guests, who may become ill or have accidents. In addition, disasters such as earthquakes, floods, storm surge and fires are real possibilities.

Mitigation

i. Have first aid kits located in various sections of the hotel.
ii. Design and implement an emergency response plan.
iii. Staff should be trained in CPR and basic first aid.
iv. Arrange mutual assistance and make prior arrangements with:
    a. Health care facilities, Noel Holmes Hospital and associated doctors and nurses to accommodate any eventualities.
    b. Arrange with other health practitioners to be on call or have an in-house physician/nurse.
    c. Lucea Fire Station (additional firefighting units and a fire boat)

d. Green Island Police Station (police personnel in addition to the Tourism Courtesy Corp Officers)

8.3.4.5 Tourism

The proposed hotel is likely to improve the tourism product of the country. No mitigation is required for this impact.

8.3.4.6 Transportation and Traffic

Level of Service – Operational Phase Traffic (No growth at 1 year)

RESULTS: ACCESS ROAD INTERSECTION 1

Traffic generated during the operational phase of the development is anticipated to be limited given most guests will be shuttled in and out of the property and staff parking will be offsite. Overall operation phase traffic will not, in any significant way, affect the delay waiting time or level of service experienced by motorists at Access Road Intersection 1. The results of the analysis for the 'Evening Hour' scenario shows that the level of service ranges between "A" to "B" for all vehicles on each leg approaching the intersection (Table 8-24, Figure 8-20). There was no noticeable delay for through traffic on the highway as those entering and or leaving the hotel are in conflict with the highway traffic which has right of way. Those leaving the hotel are required to wait until a suitable gap is found in the through traffic convoy. Overall there is no need to install any traffic signal to regulate flow given the highway traffic is largely unaffected when no traffic growth is considered.

Table 8-24 The Movement Performance at Intersection 1 for the Evening Peak Hour Scenario, Operational Phase (1 Year, No growth)

Movement Performance - Access Road 1 Intersection												
Mov	Turn	Demand Flows		Deg.	Average	Level of	95% Back of Queue		Prop.	Effective	Aver. No.	Average
ID		Total	HV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Cycles	Speed
		veh/h	%	v/c	sec		veh	m				km/h
North-East: Major Road-Lucea Side												
11	T1	284	13	0.197	**0.4**	**LOS A**	0.5	3.7	0.16	0.08	0.16	49.2
12	R2	42	25	0.197	**6.7**	**LOS A**	0.5	3.7	0.16	0.08	0.16	48
Approach		326	14.5	0.197	**1.2**	**NA**	0.5	3.7	0.16	0.08	0.16	49
North-West: Princess Hotel Access Road 1 Intersection												
1	L2	35	24.2	0.121	**10.8**	**LOS B**	0.4	3.7	0.51	0.96	0.51	48.8
3	R2	35	24.2	0.121	**14.9**	**LOS B**	0.4	3.7	0.51	0.96	0.51	48.3
Approach		69	24.2	0.121	**12.9**	**LOS B**	0.4	3.7	0.51	0.96	0.51	48.6
South-West: Major Road- Negril Side												
4	L2	35	24.2	0.179	**5.8**	**LOS A**	0	0	0	0.06	0	57
5	T1	283	14.9	0.179	**0**	**LOS A**	0	0	0	0.06	0	59.4
Approach		318	15.9	0.179	**0.7**	**NA**	0	0	0	0.06	0	59.2
All Vehicles		714	16.1	0.197	2.1	NA	0.5	3.7	0.12	0.16	0.12	53

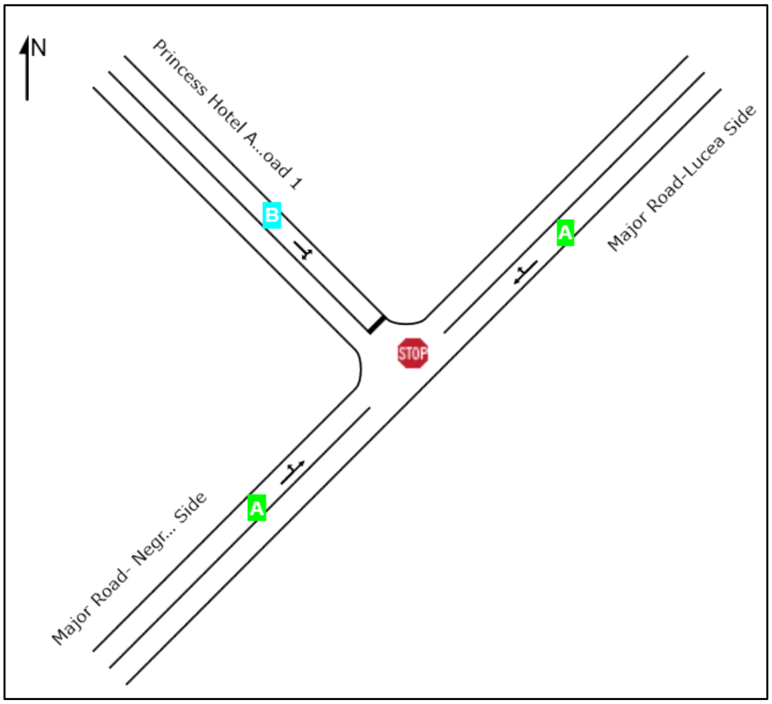


Figure 8-20 LOS at Access Road Intersection 1 (Operations – 1 year, no growth)

RESULTS: ACCESS ROAD INTERSECTION 2

As with Access Road Intersection 1, traffic generated during the operation phase will not, in any significant way, affect the delay waiting time or level of service experienced by through-traffic along Access Road 2. The results of the analysis for the 'Evening Hour' scenario shows level of service ranges between "A" to "B" for all vehicles on each leg approaching the intersection (Table 8-25, Figure 8-21). There was no noticeable delay for through-traffic on the A1 highway as those entering and or leaving the hotel are required to yield based on (A1 Highway) right of way. Those leaving the hotel are required to wait until a suitable gap is found in the through traffic to be able to exit. Overall, as with Access Road Intersection 1, there is no need to install any traffic signal to regulate flow given the highway traffic is largely unaffected when no traffic growth is considered.

Table 8-25 The Movement Performance at Intersection 2 for the Evening Peak Hour Scenario, Operational Phase (1 Year, No growth)

Movement Performance - Access Road 2 Intersection												
Mov	Turn	Demand Flows		Deg.	Average	Level of	95% Back of Queue		Prop.	Effective	Aver. No.	Average
ID		Total	HV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Cycles	Speed
		veh/h	%	v/c	sec		veh	m				km/h
North-East: Major Road-Lucea Side												
11	T1	273	12	0.183	**0.4**	**LOS A**	0.4	3	0.14	0.07	0.14	49.3
12	R2	35	24.2	0.183	**6.6**	**LOS A**	0.4	3	0.14	0.07	0.14	48.1
Approach		307	13.4	0.183	**1.1**	**NA**	0.4	3	0.14	0.07	0.14	49.2

North-West: Princess Hotel Access Road 2 Intersection												
1	L2	35	24.2	0.118	**10.8**	**LOS B**	0.4	3.6	0.5	0.96	0.5	48.9
3	R2	35	24.2	0.118	**14.5**	**LOS B**	0.4	3.6	0.5	0.96	0.5	48.4
Approach		69	24.2	0.118	**12.7**	**LOS B**	0.4	3.6	0.5	0.96	0.5	48.7
South-West: Major Road- Negril Side												
4	L2	35	24.2	0.179	**5.8**	**LOS A**	0	0	0	0.06	0	57
5	T1	283	14.9	0.179	**0**	**LOS A**	0	0	0	0.06	0	59.4
Approach		318	15.9	0.179	**0.7**	**NA**	0	0	0	0.06	0	59.2
All Vehicles		695	15.6	0.183	2	NA	0.4	3.6	0.11	0.15	0.11	53.2

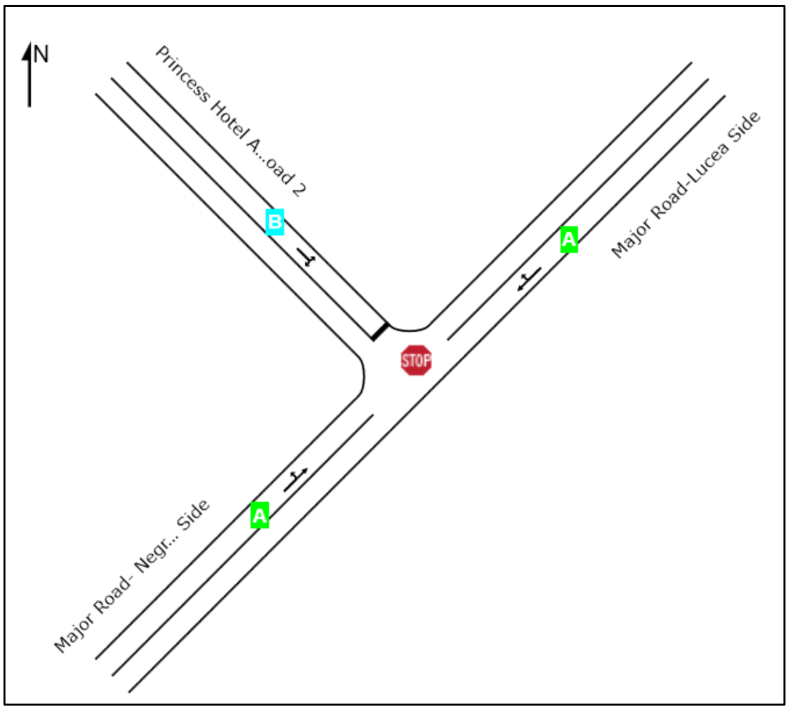


Figure 8-21 LOS at Access Road Intersection 2 (Operations – 1 year, no growth)

Level of Service – Operational Phase Traffic (Future 3% Annual Growth at 10 years)

RESULTS: ACCESS ROAD INTERSECTION 1

When traffic growth is considered at 3% growth per annum for 10 years, the Level of Service for traffic exiting the proposed Princess Hotel intersection is reduced from a “B” to a “C”, while the through traffic along the highway maintains a Level of Service of “A” (Table 8-26, Figure 8-22). This indicates that there is no immediate need to signalize this intersection, even with the consideration made for future growth (3% p.a./10 years).

Table 8-26 The Movement Performance at Intersection 1 for the Evening Peak Hour Scenario, Operational Phase (10 Years, 3% growth)

Movement Performance - Access Road 1 Intersection (3% Growth Per Annum, 10-Years)												
Mov	Turn	Demand Flows		Deg.	Average	Level of	95% Back of Queue		Prop.	Effective	Aver. No.	Average
ID		Total	HV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Cycles	Speed
		veh/h	%	v/c	sec		veh	m				km/h
North-East: Major Road-Lucea Side												
11	T1	382	13	0.274	**0.7**	**LOS A**	0.8	6.3	0.21	0.08	0.21	49
12	R2	57	25	0.274	**7.9**	**LOS A**	0.8	6.3	0.21	0.08	0.21	47.7
Approach		438	14.5	0.274	**1.7**	**NA**	0.8	6.3	0.21	0.08	0.21	48.8
North-West: Princess Hotel Access Road 1												
1	L2	47	24.3	0.224	**12.1**	**LOS B**	0.8	6.9	0.63	0.99	0.66	46.8
3	R2	47	24.3	0.224	**20.3**	**LOS C**	0.8	6.9	0.63	0.99	0.66	46.4
Approach		93	24.3	0.224	**16.2**	**LOS C**	0.8	6.9	0.63	0.99	0.66	46.6
South-West: Major Road- Negril Side												
4	L2	47	24.3	0.241	**5.8**	**LOS A**	0	0	0	0.06	0	57
5	T1	381	14.9	0.241	**0**	**LOS A**	0	0	0	0.06	0	59.4
Approach		427	15.9	0.241	**0.7**	**NA**	0	0	0	0.06	0	59.1
All Vehicles		959	16.1	0.274	2.6	NA	0.8	6.9	0.16	0.16	0.16	52.7

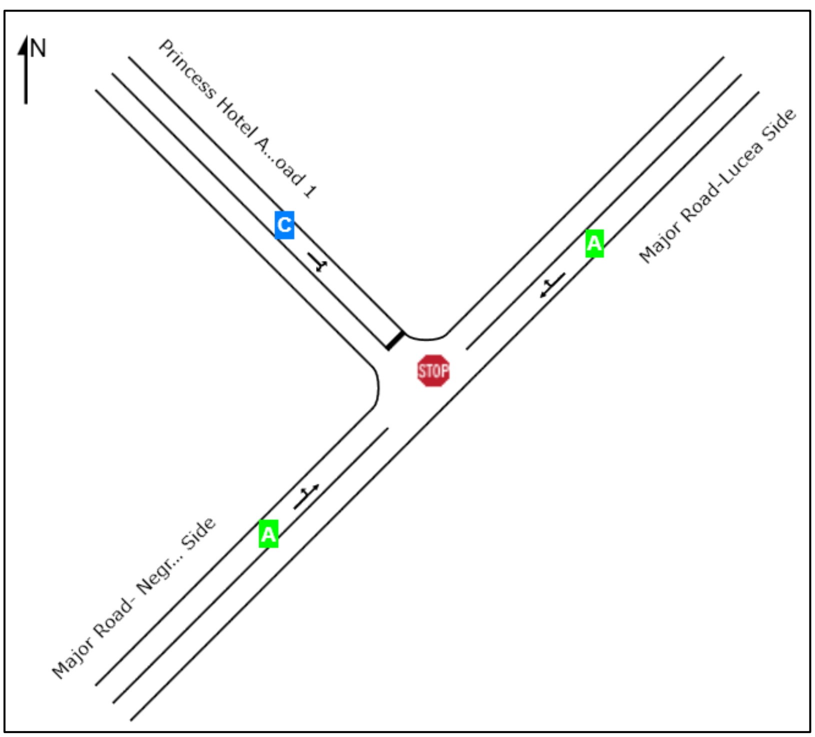


Figure 8-22 LOS at Access Road Intersection 1 (Operations – 10 years, 3% growth)

RESULTS: ACCESS ROAD INTERSECTION 2

When traffic growth is considered at 3% growth per annum for 10 years, the Level of Service for traffic exiting the proposed Princess Hotel intersection drops to a "D" from a "B", while the through traffic along the highway maintains and Level of Service of "A" (Table 8-27, Figure 8-23). Though there is no need to signalize this intersection as a Level of Service of "D" may be considered tolerable, the implementation of a signalized intersection would increase the Level of Service to traffic exiting Access Road 2.

Table 8-27 The Movement Performance at Intersection 2 for the Evening Peak Hour Scenario, Operational Phase (10 Years, 3% growth)

Movement Performance - Access Road 2 Intersection (3% Growth Per Annum, 10-Years)												
Mov	Turn	Demand Flows		Deg.	Average	Level of	95% Back of Queue		Prop.	Effective	Aver. No.	Average
ID		Total	HV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Cycles	Speed
		veh/h	%	v/c	sec		veh	m				km/h
North-East: Major Road-Lucea Side												
11	T1	446	12	0.317	**1.1**	**LOS A**	1.1	8.8	0.22	0.07	0.26	48.7
12	R2	57	24.3	0.317	**9.3**	**LOS A**	1.1	8.8	0.22	0.07	0.26	47.5
Approach		503	13.4	0.317	**2**	**NA**	1.1	8.8	0.22	0.07	0.26	48.6
North-West: Princess Hotel Access Road 2												
1	L2	57	24.3	0.355	**14.9**	**LOS B**	1.4	12.2	0.75	1.08	0.95	44.1
3	R2	57	24.3	0.355	**27.6**	**LOS D**	1.4	12.2	0.75	1.08	0.95	43.7
Approach		114	24.3	0.355	**21.3**	**LOS C**	1.4	12.2	0.75	1.08	0.95	43.9
South-West: Major Road- Negril Side												
4	L2	57	24.3	0.294	**5.8**	**LOS A**	0	0	0	0.06	0	57
5	T1	464	14.9	0.294	**0**	**LOS A**	0	0	0	0.06	0	59.4
Approach		521	15.9	0.294	**0.7**	**NA**	0	0	0	0.06	0	59.1
All Vehicles		1138	15.6	0.355	3.3	NA	1.4	12.2	0.17	0.17	0.21	52.3

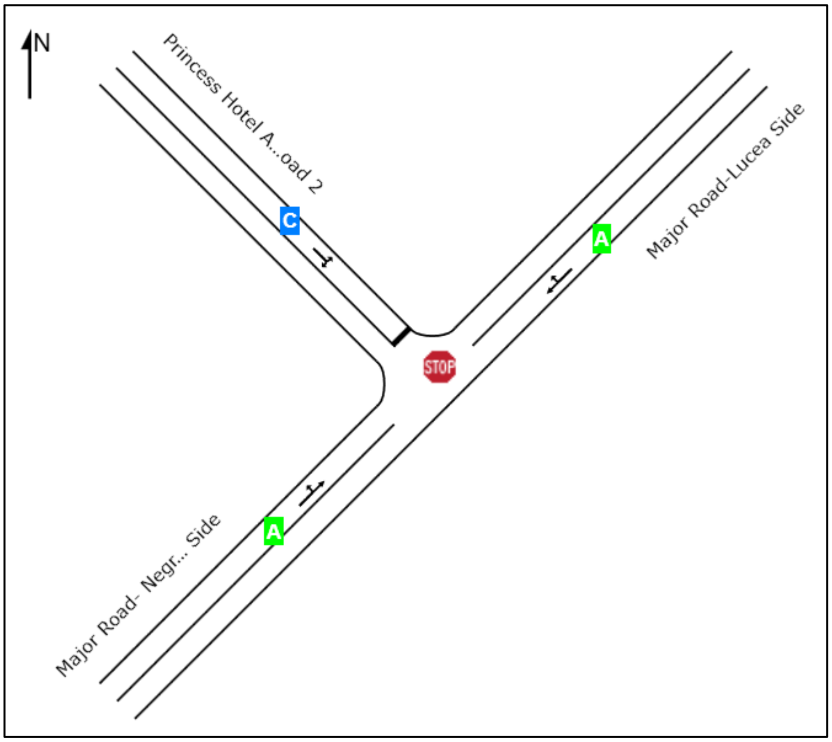


Figure 8-23 LOS at Access Road Intersection 2 (Operations – 10 years, 3% growth)

Level of Service – Operational Phase Traffic (Signalized, 10 years)

RESULTS: ACCESS ROAD INTERSECTION 1

With the implementation of an actuated signalized intersection, both vehicles travelling straight through the intersection, as well as vehicles entering and exiting, the development is expected to experience an increase in delay. This is as a result of the signalling of the lights which will be a constant impediment to the flow of through traffic, as opposed to motorists just waiting for a gap to merge onto the highway (Table 8-28, Figure 8-24).

Table 8-28 The Movement Performance at Intersection 1 for the Evening Peak Hour Scenario, Operation Phase, Signalized (10 Years)

Movement Performance - Signalized Access Road 1 Intersection (3% Growth Per Annum, 10-Years)												
Mov	Turn	Demand Flows		Deg.	Average	Level of	95% Back of Queue		Prop.	Effective	Aver. No.	Average
ID		Total	HV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Cycles	Speed
		veh/h	%	v/c	sec		veh	m				km/h
North-East: Major Road-Lucea Side												
11	T1	382	13	0.486	**6.8**	**LOS A**	4.3	33.6	0.67	0.58	0.67	45.5
12	R2	57	25	0.486	**11.9**	**LOS B**	4.3	33.6	0.7	0.63	0.7	44.2
Approach		438	14.5	0.486	**7.4**	**LOS A**	4.3	33.6	0.67	0.59	0.67	45.3
North-West: Princess Hotel Access Road 1												
1	L2	47	24.3	0.348	**21.3**	**LOS C**	1.6	13.1	0.9	0.75	0.9	43

3	R2	47	24.3	0.348	**21.2**	**LOS C**	1.6	13.1	0.9	0.75	0.9	42.9
Approach		93	24.3	0.348	**21.3**	**LOS C**	1.6	13.1	0.9	0.75	0.9	42.9
South-West: Major Road- Negril Side												
4	L2	47	24.3	0.06	**11.2**	**LOS B**	0.4	3.7	0.54	0.67	0.54	49.1
5	T1	381	14.9	0.436	**6.8**	**LOS A**	4.4	34.8	0.68	0.58	0.68	53.9
Approach		427	15.9	0.436	**7.3**	**LOS A**	4.4	34.8	0.66	0.59	0.66	53.3
All Vehicles		959	16.1	0.486	**8.7**	**LOS A**	4.4	34.8	0.69	0.61	0.69	48.3

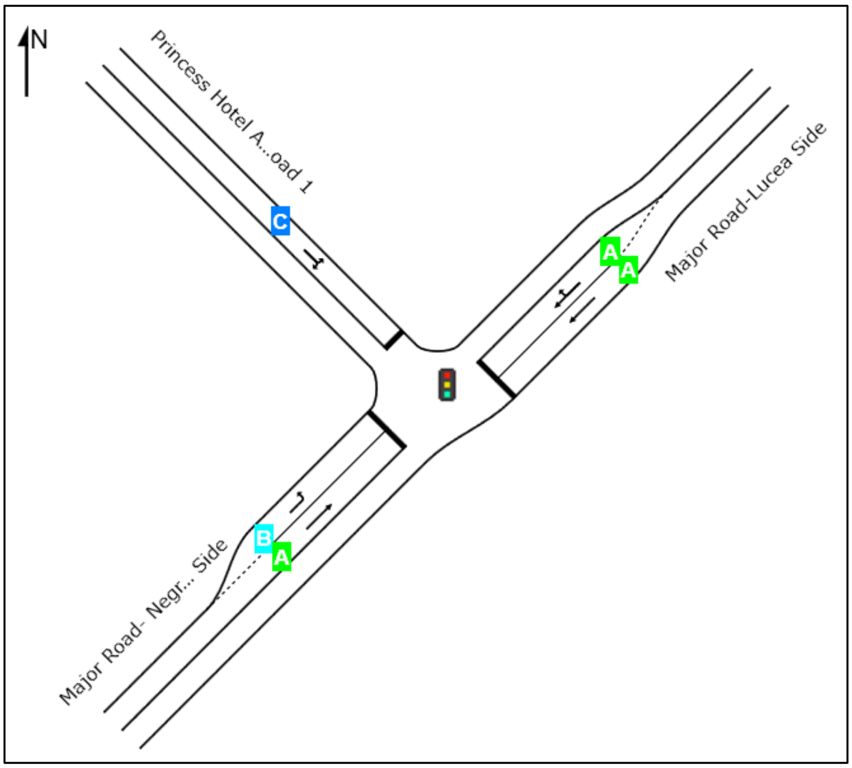


Figure 8-24 LOS at Access Road Intersection 1 (Operations – 10 years, Signalized)

RESULTS: ACCESS ROAD INTERSECTION 2

As with Intersection 1, the implementation of an Actuated Signalized Intersection results in a general increase in the delay, however motorists attempting to make a right turn, towards Negril, when leaving the hotel will have an increase in delay from “D” to “C”. Like Intersection 1, the general reduction in Level of Service as a result of the signalling of the lights which will be a constant impediment to the flow of traffic, as opposed to motorists just waiting for a gap to merge into the highway (Table 8-29, Figure 8-25).

Table 8-29 The Movement Performance at Intersection 2 for the Evening Peak Hour Scenario, Operation Phase, Signalized (10 Years)

Movement Performance - Signalized Access Road 2 Intersection (3% Growth Per Annum, 10-Years)												
Mov	Turn	Demand Flows		Deg.	Average	Level of	95% Back of Queue		Prop.	Effective	Aver. No.	Average
ID		Total	HV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Cycles	Speed
		veh/h	%	v/c	sec		veh	m				km/h
North-East: Major Road-Lucea Side												
11	T1	446	12	0.52	**7.3**	**LOS A**	5.5	43.3	0.66	0.58	0.66	45.2
12	R2	57	24.3	0.52	**12.7**	**LOS B**	5.5	43.3	0.71	0.64	0.71	43.8
Approach		503	13.4	0.52	**7.9**	**LOS A**	5.5	43.3	0.67	0.59	0.67	45
North-West: Princess Hotel Access Road 2												
1	L2	57	24.3	0.416	**23.5**	**LOS C**	2.2	18.3	0.91	0.77	0.91	41.9
3	R2	57	24.3	0.416	**23.4**	**LOS C**	2.2	18.3	0.91	0.77	0.91	41.8
Approach		114	24.3	0.416	**23.5**	**LOS C**	2.2	18.3	0.91	0.77	0.91	41.8
South-West: Major Road- Negril Side												
4	L2	57	24.3	0.093	**11.2**	**LOS B**	0.8	6.7	0.51	0.6	0.51	50.3
5	T1	464	14.9	0.467	**6.8**	**LOS A**	5.6	43.9	0.65	0.57	0.65	53.8
Approach		521	15.9	0.467	**7.3**	**LOS A**	5.6	43.9	0.63	0.57	0.63	53.4
All Vehicles		1138	15.6	0.52	**9.2**	**LOS A**	5.6	43.9	0.68	0.6	0.68	48.1

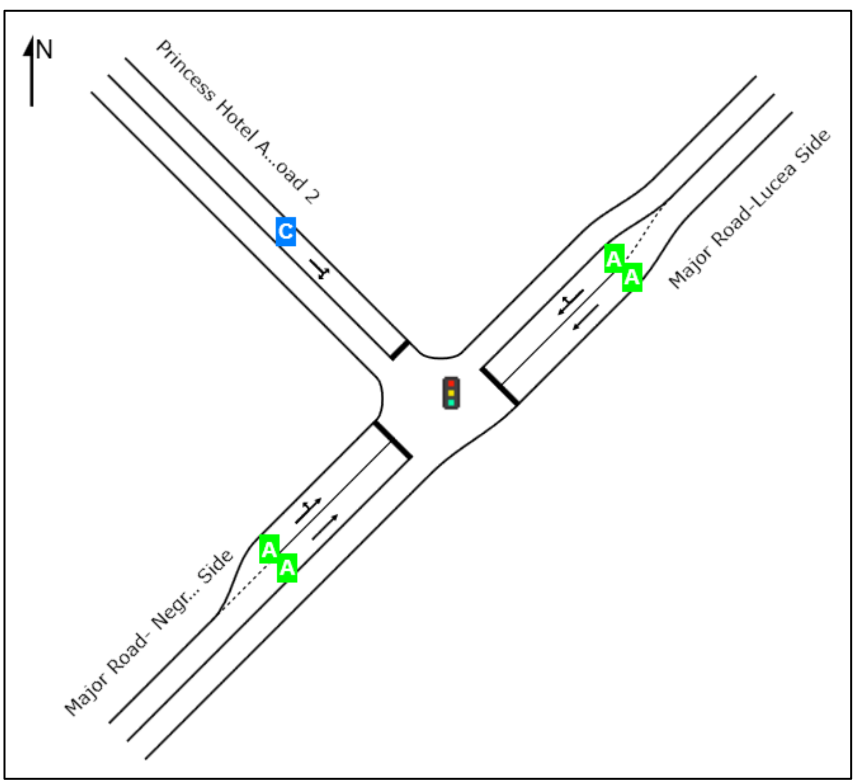


Figure 8-25 LOS at Access Road Intersection 2 (Operations – 10 years, Signalized)

SUMMARY

From the analysis, traffic travelling along the through lanes to Negril and Lucea are not significantly affected during the operational phases. Vehicles entering and exiting the hotel property are expected to experience tolerable delays for short periods. With the implementation of an Actuated Signalized Intersections, the delay for the vehicles is generally increased, thus decreasing the LOS (Table 8-30 and Table 8-31).

Table 8-30 Summary of Access Road 1 Intersection Scenarios during various operational phases

Access Road 1 Intersection	North-East: Major Road-Lucea Side				South-West: Major Road- Negril Side				North-West: Princess Hotel Access Road 1			
	Through		Right		Left		Through		Left		Right	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Operational Phase	0.4	A	6.7	A	5.8	A	0	A	10.8	B	14.9	B
Future Operational Phase (10 years)	0.7	A	7.9	A	5.8	A	0	A	12.1	B	20.3	C
Future Operational Phase (Signalized 10yrs)	6.8	A	11.9	B	11.2	B	6.8	A	21.3	C	21.3	C

Table 8-31 Summary of Access Road 2 Intersection Scenarios during various operational phases

Access Road 2 Intersection	North-East: Major Road-Lucea Side				South-West: Major Road- Negril Side				North-West: Princess Hotel Access Road 2			
	Through		Right		Left		Through		Left		Right	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Operational Phase	0.4	A	6.6	A	5.8	A	0	A	10.8	B	14.5	B
Future Operational Phase (10 years)	1.1	A	9.3	A	5.8	A	0	A	14.9	B	27.6	D
Future Operational Phase (Signalized 10yrs)	7.3	A	12.7	B	11.2	B	6.8	A	23.5	C	23.4	C

RECOMMENDED MITIGATION

Both the present and future Level of Service (LOS) determined for the Green Island North Coast Highway, particularly at the intersections, was concluded as “A” for the through peak traffic flow, with no observed delays. Traffic entering and exiting the intersections will experience minimum LOS values ranging from “B” to “D” given the fact that obstruction by the through traffic is expected. The delays (worst case) can be as much as twenty-eight (28) seconds for vehicles attempting to enter the highway. Princess Hotel therefore has three (3) viable options moving forward with these two (2) entrances:

1. **Signalize the entrance** – Princess Hotel may choose to apply to the NWA for a traffic signal. However, it is not recommended to implement signalized intersections in this area as they will result an increase in delay for through traffic. From a safety perspective, the installation of the traffic signal *may* encourage reduced vehicular speeds, consequently improving general public welfare safety at the intersections.

2. **Signage** – Installation of signs along the major road to warn motorists approaching each intersection, in accordance with NWA specifications. Signs instructing motorists to reduce their speed will significantly reduce the possibility of road accidents caused by the presence of the intersections.

3. **Keep the entrance un-signalized** - The assessment revealed that it is not necessary for either intersection to be signalized as the volume of traffic does not warrant the installation. However, the implementation of acceleration and deceleration lanes may decrease the frequency of accidents in the area.

8.4 OVERWATER STRUCTURES

8.4.1 Construction

8.4.1.1 Physical

Water Quality

Sedimentation of the water column and nearby reef and seagrass beds is possible as a result of construction activities within the proposed overwater rooms areas. A construction pad will be built using boulders to facilitate overwater structure construction. The construction will span several months and if a solid construction pad is used, some stagnation of the water behind the pad is likely.

RECOMMENDED MITIGATION

1. During construction, the project site should include sediment control measures such as turbidity barriers/silt screens and should be erected around the entire work area to prevent the dispersion of sediments and contaminants throughout the water column.
2. Weekly monitoring of water quality parameters such as temperature, salinity, pH, Dissolved Oxygen, light irradiance, turbidity and Total Suspended Solids (TSS) in and around the project area should be conducted during construction for the first 3 months of construction. Monitoring can be conducted fortnightly thereafter.
3. Conduct sediment dispersal calculation rates on coral reefs and seagrass beds within 200 meters of the proposed overwater villas and at control stations, on a monthly basis, for comparison to background levels and pre-construction sedimentation rates.
4. Culverts will be constructed through the construction pad to allow for exchange of water. (Figure 8-26). Figure 8-27 shows that a contaminant introduced behind a construction pad would reduce in concentration to below 10% in less than 21 hours. This contaminant could be all the suspended spoils of construction including silt and oil. Figure 8-28 shows the flushing that two 15m wide culverts would provide.

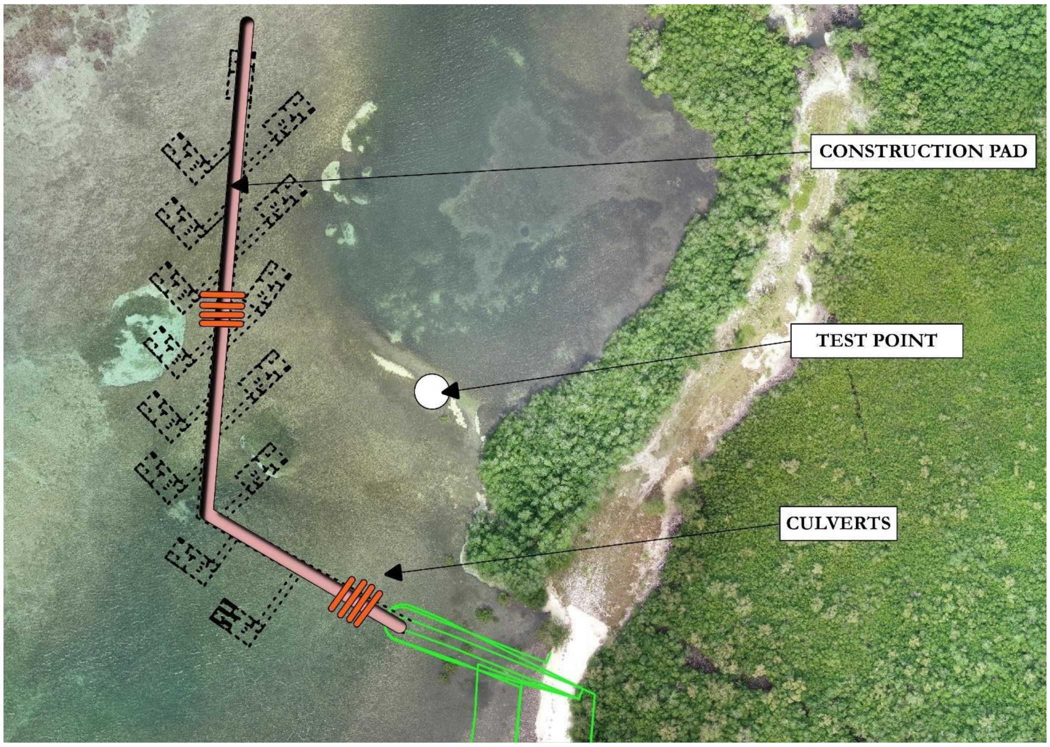


Figure 8-26 Schematic showing the layout of the construction pad and culverts for the searooms

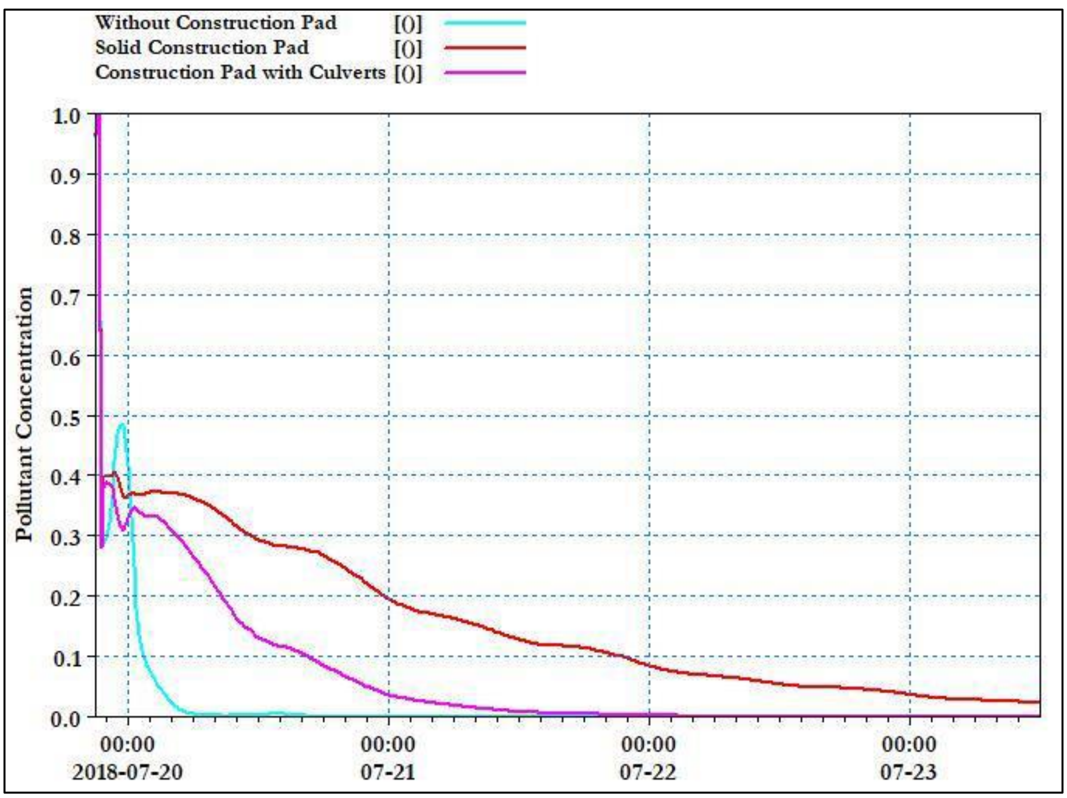


Figure 8-27 Flushing potential with and without construction pad at the test point shown in Figure 8-26.

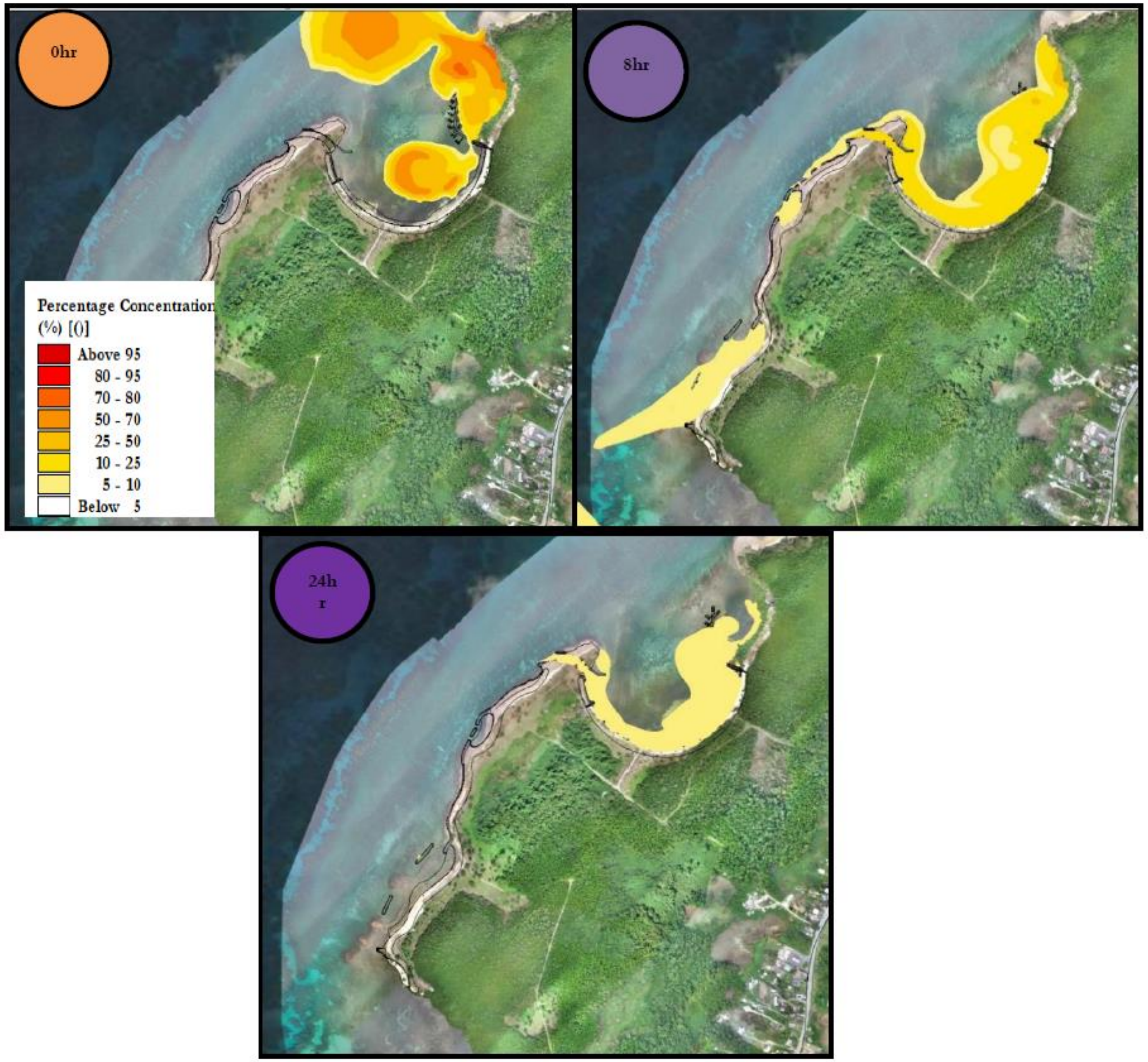


Figure 8-28 Flushing provided by construction of two, 15-metre wide culverts

Noise Pollution

Construction necessitates the use of heavy equipment to carry out the job. These possess the potential to have a direct negative impact on the noise climate. Noise directly attributable to construction activity should not result in noise levels in the residential areas to exceed 55dBA during daytime (7am – 10 pm) and 50 dBA during nighttime (10 pm – 7 am). Where the baseline levels are above the stated levels then it should not result in an increase of the baseline levels by more than 3dBA. Construction noise can result in short-term impacts of varying duration and magnitude. The construction noise levels are a function of the scale of the project, the phase of the construction, the condition of the equipment and its operating cycles, the number of pieces of construction equipment operating concurrently.

RECOMMENDED MITIGATION

i. Use equipment that has low noise emissions as stated by the manufacturers.
ii. Use equipment that is properly fitted with noise reduction devices such as mufflers.
iii. Operate noise-generating equipment during regular working hours (e.g. 7 am – 7 pm) to reduce the potential of creating a noise nuisance during the night.
iv. Construction workers operating equipment that generates noise should be equipped with noise protection. A guide is workers operating equipment generating noise of ≥ 80 dBA (decibels) continuously for 8 hours or more should use earmuffs. Workers experiencing prolonged noise levels 70 - 80 dBA should wear earplugs.

8.4.1.2 Biological

During construction, several aspects of the biological environment may be impacted. These impacts include; excess sedimentation, reduced water quality, habitat fragmentation, habitat loss and/or modification, species loss and/or displacement, mechanical damage to sensitive organisms and/or ecosystems and shading as a result of the over water structures. As a result, the following mitigation measures should reduce the potential impact to the biological environment.

Primary Mitigation Measures

1. During construction, the project site should include sediment control measures such as turbidity barriers/silt screens and should be erected around the entire work area to prevent the dispersion of sediments and contaminants throughout the water column. These should be placed so as to reduce/contain the resultant sediment plume during the activities. Construction activities should only continue when these barriers are fully operational, that is; placed correctly; calm to moderate sea conditions; without damage. These barriers are particularly important when operations occur near or may influence sensitive ecosystems and species such as coral reefs and seagrass beds and or filter feeding organisms and fish.
2. Weekly monitoring of water quality parameters such as temperature, salinity, pH, Dissolved Oxygen, light irradiance, turbidity and Total Suspended Solids (TSS) in and around the project area should be conducted during construction for the first 3 months of construction. Monitoring can be conducted fortnightly thereafter.
3. Conduct sediment dispersal calculation rates on coral reefs and seagrass beds within 200 meters of the proposed villas and at control stations, on a monthly basis, for comparison to

background levels. Pre-construction sedimentation rates should therefore also be conducted and used as a baseline for comparison.

4. All activities should be limited to the minimal working area, and as such reducing the extent of the footprint. No activities and or placement of anchors or materials should be done placed outside the approved area.
5. Relocation of sensitive species should be done if; they are suitable for relocation (that is suitable substrate, health and over all viability), those species fall within the potential impact area; and if mobile invertebrates are in or around the potential impact area. Sensitive organisms and systems in and outside the impact area include; hard and soft corals, sponges, seagrass and mobile invertebrates such as urchins, sea cucumbers, starfish and conch. Detailed Seagrass and Coral Removal and Relocation Plans, as well as a Post-Relocation Monitoring Plan, must be prepared for approval by NEPA.
6. Alternative mitigations should be proposed when relocation is unlikely to be successful.
7. Where possible, as little of the natural environment should be relocated or removed. Habitat fragmentation and species displacement should be temporary, with the placement of silt screens, construction materials and equipment as well as general human activity in the area.
8. Structures placed on the seafloor may cause habitat fragmentation and displace some species, however they may also serve to add ecological volume, providing substrate for organisms to settle and colonize and eventually may serve some ecosystem functions.
9. Any temporary floating structures and /or vessels should be placed in areas with less sensitive species where possible. Floating structures anchored or moored over seagrass beds or coral colonies should not be left for prolonged time periods as the resulting shading effects may cause deterioration in overall health of the seagrass bed and coral colonies.

Seagrass

A 5-metre buffer outside of the project footprint was applied to account for the active working area and accidental seagrass damage during construction.

Seagrass Survey Site 1 (overwater searooms) is located within the Eastern end of Negro Bay. The impact area of the seagrass bed may affect 5,126.18 m^2 of seagrass, comprising 5,120.74 m^2 *Thalassia* and 5.44 m^2 *Halodule*. This location consists of mainly sandy substrate. An estimated **100%** of this total area can undergo relocation based on suitable substrate type (Figure 8-3).

Seagrass beds found directly in the footprint may also be shaded by the various floating structures/vessels during construction. Some seagrasses may tolerate a certain amount of shading as they are adapted to turbid, lower light conditions. Too much shading may result in the deterioration of the seagrass health and functionality and even loss of species and eventually habitat.

Sedimentation may result in the smothering of seagrass blades and the epiphytes which live on these blades resulting in habitat and species loss. Light penetration may also be reduced by various activities. The reduced water quality may result in reduced photosynthesis of the seagrass beds. Other sessile and filter feeding species living in or on these beds may also be affected.

There is a potential for mechanical abrasions (loss and damage) from the construction activities, including; anchor damage and placement of moorings. This may result in habitat loss, fragmentation and even death of sensitive species.

Recommended Mitigation: See Primary Mitigation Measures 1-9 above

Coral and associated Sessile Fauna

Nearby and surrounding reef systems, coral colonies and other sessile animals may be impacted by excess sedimentation. Any prolonged or excess sedimentation as a result of the site preparation and construction activities may cause harm, stress and even death to sensitive species.

Acropora palmata colonies were observed 50 metres northwest of the northern-most searoom (Figure 6-63). Coral pavement as well as the fringing barrier reef which are home to other highly sensitive coral species, are also in the immediate vicinity of the overwater searooms.

Hard corals can be very sensitive to sedimentation. It may have an effect which may result in a loss of species and or habitat, if prolonged. Reduced water quality and light penetration may also negatively impact these animals. Filter feeding and photosynthetic activities may be impaired or prevented during excess or prolonged sedimentation.

Recommended Mitigation: See Primary Mitigation Measures 1-9 above

Fish

Site preparation and construction activities may result in the temporary loss and/or displacement of any fish and or fish habitat. The excess sedimentation may result in clogging of fish gills and may result in their death. There may be a reduction in food supply as a result of reduced water quality and the resultant changes in the plankton composition.

Recommended Mitigation: See Primary Mitigation Measures 1-4 above

Sea Turtles

Site preparation and construction activities may result in the temporary displacement of any sea turtles that utilize the nearby marine environment and beach for nesting. Displacement may occur as a result of; silt screens and other barriers and equipment being utilized, this may prevent/limit access to various habitats and pathways (fragmentation).

Nesting turtles maybe particularly sensitive to varying and increased noise (Wendy E.D Piniak, 2016). Studies carried show that turtle have auditory cues however the impact of noise on their ecology is not fully known. The turtle activity in the area is carefully monitored.

Lighting used during any night-time construction activities has the potential to interfere with nesting and navigation of some species.

RECOMMENDED MITIGATION

i. Attempts should be made to schedule the majority of the construction period outside of turtle nesting season (May – October).

ii. All staff and workers should be sensitized to the all sensitive ecosystems and species in the area, in particular turtles. The site should be inspected daily for any signs of turtle activity. If a nest is suspected or found, all activity nearby should stop until an expert can determine if there is a nest and how to relocate the eggs.

iii. The stakeholders, proponents and the NEPA should develop clear lines of reporting and communication in the event that action needs to be taken.

iv. Silt screens should be used to prevent sedimentation but should be removed promptly along with any other construction debris and material upon completion.

v. Night-time activities should be limited or avoided when possible. No lights should be pointed out to sea confusion and disorientation of turtles or any other species that maybe affected by lunar activity.

vi. Fixtures in direct line-of-sight from the beach should be shielded down-light only fixtures or recessed fixtures having low wattage "bug" type bulbs and non-reflective interior surfaces.

vii. Fixtures mounted as low in elevation as possible through use of low-mounted wall fixtures, low bollards and ground level fixtures.

viii. Floodlights, up-lights or spotlights for decorative and accent purposes that are directly visible from the beach or which indirectly or cumulatively illuminate the beach shall not be used.

ix. For high intensity lighting applications such as providing security and similar applications shielded low-pressure sodium vapour lamps and fixtures shall be used.

8.4.1.3 Human and Social

Maritime Traffic

Construction activity may have the potential to negatively impact fishing and other maritime activities taking place at sea due to vessels, machinery and equipment in the water being used during the construction process. Accident potential is also increased due to presence of vessels, structures and equipment at sea.

RECOMMENDED MITIGATION:

The use of highly visible marker buoys demarcating an exclusion zone should be used to keep out other marine traffic and fishers from the work area to prevent potential accidents.

Health and Safety

Construction will involve numerous construction workers and supervisors, both above water and in the water, during peak period. The possibility of accidental injury is high. There may be either minor or major accidents.

MITIGATION

i. A lead person should be identified and appointed to be responsible for emergencies occurring on the site. This person should be clearly identified to the construction workers.
ii. At least two (2) certified lifeguards should be hired and be on site during work hours in the event of potential accidental drowning.
iii. The construction management team should have onsite first aid kits and make arrangements for the nurse and doctor at Noel Holmes Hospital in Lucea to be on call for the construction site. Prior arrangements should be made with health care facilities/clinics to accommodate any eventualities.
iv. Make prior arrangements with the Lucea Fire Station and Green Island Police Station to accommodate any eventualities.
v. Material Safety Data Sheets (MSDS) should be stored onsite.

Aesthetics

Construction activities may decrease the aesthetic appeal of the area; however, this will be for a short-term period during construction.

RECOMMENDED MITIGATION

Good housekeeping activities and adherence to other mitigative measures especially with regard to potential marine water quality contamination.

8.4.2 Operation

8.4.2.1 Physical

Operational currents and sediment transport are discussed in Sections 8.3.1.2 and 8.3.1.3 respectively, while swell wave conditions, hurricane wave conditions/storm surge are discussed in Sections 8.3.3.1 and 8.3.3.2 respectively.

8.4.2.2 Biological

Reef and Seagrass Communities

Reef and Seagrass communities, corals and other sessile organisms which live on the pavement near to the impact area (sponges, gorgonians, tube worms, fanworms) should return to normal conditions.

Pilings provide some ecological volume both on the seafloor and in the water column. Hard structures will provide substrate for colonization which should change in composition over time.

Fish

Fish may benefit from the pilings and shaded areas. These will act FADs (Fish Aggregation Devices). This area may also be more managed and as a result the fish may benefit from some protection from overfishing. Filter feeders should see normal conditions return over time.

Sea Turtles

Turtles should see somewhat normal conditions return over time. However, turtles may experience some habitat fragmentation and loss of food sources from any modification to the seagrass beds in the area. In addition, the searooms act as permanent obstacles which may deter turtles from returning to nest on the beach. Increased noise and lighting may affect and deter turtles from nesting.

MITIGATION

Turtle-friendly lighting and light positioning (if any) should also be placed on the searooms. Hotel operators should also educate their guests on sea turtle conservation and the correct actions to take if a sea turtle is observed nesting on the beach.

The Hotel should also develop a Sea Turtle Monitoring programme which would include tagging and hatchling release.

8.4.2.3 Natural Hazards

Storm Surge

Section 5.4.2.3 discusses the recommended floor levels for the searooms to avoid any damage due to storm surge.

Climate Change

The design calculations for the proposed searooms included projections for sea level rise to the year 2100. Even with the anticipated increase in sea levels the site would not be flooded in 50-year storm event.

8.4.2.4 Human and Social

Maritime Traffic

The existence of the over water searooms may have the potential to negatively impact other maritime activities taking place. There is also the potential for accidental collision with the structure during the night-time.

MITIGATION

After construction is completed, permanent highly visible marker buoys should be placed at strategic points around the overwater rooms. Turtle-friendly lighting and light positioning should also be placed on the searooms so that they are visible to marine vessels at nighttime.

Aesthetics

The proposed sea rooms are likely to improve the aesthetic appeal of the hotel.

No mitigation is required for this impact.

Emergency Response

IMPACT

The operation of the proposed searooms will involve workers and guests, who may become ill or have accidents. In addition, disasters such as storm surge and fires are real possibilities.

MITIGATION

- Have first aid kits located in various sections of the hotel.
- Design and implement an emergency response plan.
- Staff should be trained in CPR and basic first aid.
- Arrange mutual assistance and make prior arrangements with:
  - Health care facilities, Noel Holmes Hospital and associated doctors and nurses to accommodate any eventualities.
  - Arrange with other health practitioners to be on call or have an in-house physician/nurse.
  - Lucea Fire Station (fire boat)
  - Green Island Police Station (Marine police to conduct patrols in the vicinity of the overwater searooms). This may also be conducted by contracted private security.

Tourism

The proposed sea rooms are likely to improve the tourism product of both the hotel and the country.

No mitigation is required for this impact.

8.5 CUMULATIVE IMPACTS

8.5.1 Mangrove Forest

There will be additional water drainage into the mangrove forest as a result of the proposed project, as detailed in Section 8.3.1.1.

Drainage into the mangrove swamp from the grounds of the proposed hotel property have the potential to affect water quality in the form of suspended solids, solid waste and oil and grease. Effective surface water management will be necessary to minimize the impact of added runoff into the mangrove forest.

8.5.2 Water Supply

Water consumption is estimated to be 90,138.57m^3/month (≈ 23,812,091 US gal/month). This equates to approximately 3,005 m^3/day (≈ 800,000 US gal/day). This increase in water demand will need to be fulfilled by the NWC Logwood Treatment Plant, the capacity of which is 7 million gallons per day. Currently the plant supplies between 4 and 5 million gallons of water per day and the Negril area specifically (including parts of Hanover in which the proposed development is located) uses approximately 4 million gallons of water per day. The NWC Logwood Treatment Plant should therefore be able to accommodate the increased water demand of the new development without overburdening the public water supply system.

8.5.3 Solid Waste

Construction debris, raw materials and packaging materials etc. associated with construction activities will add to the amount of solid waste generated in the area to be collected and disposed of. During operations, increased hazardous waste from fuel and chemical containers etc. will add to the amounts of solid waste being generated. Potential accidental spills of hazardous material should also be taken into account and its possible effect on water, air and soil resources.

9.0 MITIGATION

Table 9-1 and Table 9-2 below show a summary of the various potential impacts and recommended mitigation measures for each impact, during site preparation/construction and operations respectively.

Table 9-3 and Table 9-4 show potential impacts and recommended mitigation specific to the overwater searoom structures, during construction and operation respectively.

Table 9-1 Summary Table for Potential Impacts and Mitigation during Site Preparation and Construction

CATEGORY		POTENTIAL IMPACT	RECOMMENDED MITIGATION
Physical	Drainage and Runoff	Sedimentation and pollution of mangrove forest	A construction drainage plan will be developed to control the discharge of oil/lubricants, sediment and debris into the mangrove areas, consisting of: • Site grading • Sediment retention basins and other measures for minimizing the transport of sediment • Grease traps and/or oil water separators.
	Water Quality	Sedimentation of marine environment from beach works	• The project site should utilize sediment control measures such as turbidity barriers/silt screens and should be erected around the entire work area to prevent the dispersion of sediments and contaminants throughout the water column. • A central area will be designated for the storage of chemicals. This area should be lined in order to prevent the leakage of chemicals into the sediment. • Fine grained materials (sand, marl, etc.) will be stockpiled away from drainage channels and low berms will be placed around the piles which themselves will be covered with tarpaulin to prevent them from being eroded and washed away. Silt fences may also be utilized to prevent siltation. • All boulders used for coastal structures should be washed at a designated area at the quarry before being transported to the site. The boulders should be stored in a designated area away from any fines and mud before being placed in the marine environment. • Raw materials that generate dust should be covered or wetted frequently to prevent them from becoming air or waterborne. • Raw material and equipment should be stored on impermeable hard stands surrounded by berms to contain any accidental surface runoff. • Bulk storage of fuels and oils should be in clearly marked containers (tanks/drums etc.) indicating the type and quantity being stored. In addition, these containers should be surrounded by bunds to contain the volume being stored in case of accidental spillage. • Refuelling of boats should only be done at anchor out at sea if the sea conditions are calm, otherwise, all refuelling should be done when docked at land. Appropriate refuelling equipment (such as funnels) and techniques should always be used. • Appropriate minor spill response equipment (for containment and clean- up) will kept on site, including oil absorbent pads and disposal bags. • In terms of transporting equipment, the paths of the planned roadways will be used, rather than creating temporary pathways just for equipment access. • Raw materials such as marl and sand should be adequately covered within the trucks to prevent any escaping into the air and along the roadway. • Vehicle refuelling facilities must be situated on impermeable surfaces served by an oil trap, run-off collection system. Sediment basins and oil water separators should be constructed to intercept storm water before it is discharged.
		Pollution of marine environment from fuel, lubricants, hazardous substances from construction equipment	
	Dredging	Increased suspended solids, turbidity, BOD and the reduction in light penetration and dissolved oxygen in the water column	• Turbidity barriers/silt screens are recommended to be used around all dredging activities. These should be placed so as to reduce/contain the resultant sediment plume during these activities. Dredging activities should only occur when these barriers are fully operational, that is; placed correctly; in calm to moderate sea conditions; and without damage. These barriers are particularly important when operations occur near or may influence sensitive ecosystems and species such as coral reefs and seagrass beds and or filter feeding organisms. The silt screens should encircle the areas and be deep enough to contain the plumes so that plumes will not travel in the direction of the prevailing currents. • Care should be taken to dredge only in approved dredge areas. Dredge areas and a buffer area should be demarcated to avoid accidental dredging in unauthorized areas. • Dredging operations should be continually monitored to ensure equipment and machinery are in good repair and regularly serviced to prevent oil leaks during regular operations. • Dredge spoils deposited on land will be placed in a bermed holding area for dewatering after the fines have settled and then the material transferred to trucks to be either disposed of or used on site if needed.
		Suspension of heavy metals from the substrate	
		Affect sensitive coastal ecological habitats	
	Noise	Noise nuisance from construction equipment on surrounding residential and educational communities	• Use equipment that has low noise emissions as stated by the manufacturers. • Use equipment that is properly fitted with noise reduction devices such as mufflers.

CATEGORY		**POTENTIAL IMPACT**	**RECOMMENDED MITIGATION**
			• Operate noise-generating equipment during regular working hours (e.g. 7 am – 7 pm) to reduce the potential of creating a noise nuisance during the night. • Construction workers operating equipment that generates noise should be equipped with noise protection. A guide is workers operating equipment generating noise of ≥ 80 dBA (decibels) continuously for 8 hours or more should use earmuffs. Workers experiencing prolonged noise levels 70 - 80 dBA should wear earplugs.
	Air Quality	Dust nuisance from transportation of raw material on surrounding residential and educational communities	• Areas should be dampened every 4-6 hours or within reason to prevent a dust nuisance and on hotter days, this frequency should be increased. • Minimize cleared areas to those that are needed to be used. • Cover or wet construction materials such as marl to prevent a dust nuisance. • Where unavoidable, construction workers working in dusty areas should be provided and fitted with N95 respirators.
		Fugitive dust effect on construction workers and residential communities	
Biological	Mangrove Community	Loss of 4.128 hectares (10.18 acres) of mature mangrove forest and less robust mangrove forest	• Mangrove rehabilitation is proposed in select degraded areas. Approximately 8.68 acres of potential mitigation/compensation areas were found within the property boundary. • Parking and Industrial Areas alone require 6.57 acres of the 10.18 acres of mangrove forest to be cleared. Discussions will be had with the Hanover Municipal Corporation to request a reduction in the number of parking spaces needed. • Use of Solar power generation for an overall net positive reduction in CO_2 emissions <u>Boardwalk Related Mitigation:</u> • The boardwalk should be constructed in stages (finishing one section and moving on in a continuous buildout plan) and without the use of heavy equipment to reduce the potential impact area. • Construction should not be undertaken during periods of heavy rain/ rainy season. • Construction materials should be natural and blend in with the forest to reduce the visual impact of fauna. The materials should be strong, rust resistant and should not be treated with chemicals which may leach into the environment. • The use of hazardous or toxic substances should not be undertaken in or near waterways. • Older and larger mangrove trees should be avoided
		Natural closing of drainage pathways affecting hydrology within mangrove forest	The tidal creek (adjacent to Transect 9) should be maintained with little or no disturbance. It may be beneficial to erect a concrete structure in this location to prevent natural mangrove forest growth which may enclose this vital exchange point.
		Urban sprawl and informal settling in neighbouring mangrove forests	Steps must be taken by the Contractor and respective agencies to not only conserve the wetlands at the proposed impact site, but also prevent further informal settlement sprawl in other neighbouring wetlands.
	Terrestrial Fauna	Displacement of the "IUCN Vulnerable" West Indian Whistling Ducks on site	• Efforts should be made to retain some areas of the wetland habitat for the ducks to continue to occupy. This may include the development of bird sanctuary. • Boardwalk viewing areas should also be created for guest educational purposes and bird watching.
		Displacement of the "IUCN Near Threatened" Endemic Rock Frog on site	Efforts should be made to preserve some of the mangrove trees and associated bromeliads (primary habitat for the endemic rock frog (*Eleutherodactylus cundalli*) on the property.
		Possible presence of crocodiles in the area and interactions with construction workers	The site should be fenced, and signage should be placed around the site informing and educating construction crews about the possibility of crocodiles and what to do if one is observed. Any sighting of a crocodile in the area at any stage of the project should be reported to the National Environment and Planning Agency (NEPA).
	Coral and sessile fauna	Species Loss	Coral Relocation
		Smothering of sensitive nearby coral and reduced light from sedimentation	• During construction, the project site should include sediment control measures such as turbidity barriers/silt screens and should be erected around the entire work area to prevent the dispersion of sediments and contaminants throughout the water column. These should be placed so as to reduce/contain the resultant sediment plume during the activities. Construction activities should only continue when these barriers are fully operational, that is; placed correctly; calm to moderate sea conditions; without damage. These barriers are particularly important when operations occur near or may influence sensitive ecosystems and species such as coral reefs and seagrass beds and or filter feeding organisms and fish. • Weekly monitoring of water quality parameters such as temperature, salinity, pH, Dissolved Oxygen, light irradiance and turbidity in and around the project area, for the first 3 months during construction. Monitoring can be conducted fortnightly thereafter.
		Impaired filter feeding and photosynthesis from prolonged sedimentation	
	Seagrass	Species loss and habitat fragmentation	
		Temporary shading by floating structures/vessels	
		Smothering of seagrass blades and epiphytes from sedimentation	
		Reduced light penetration and resulting decrease in photosynthesis	
		Mechanical abrasion from moorings and anchors	

CATEGORY	POTENTIAL IMPACT	RECOMMENDED MITIGATION
		• Conduct sediment dispersal calculation rates on coral reefs and seagrass beds within 200 meters of the proposed villas and at control stations, on a monthly basis, for comparison to background levels. Pre-construction sedimentation rates should therefore also be conducted and used as a baseline for comparison. • All activities should be limited to the minimal working area, and as such reducing the extent of the footprint. No activities and or placement of anchors or materials should be done placed outside the approved area. • Relocation of sensitive species should be done if; they are suitable for relocation (that is suitable substrate, health and over all viability), those species fall within the potential impact area; and if mobile invertebrates are in or around the potential impact area. Sensitive organisms and systems in and outside the impact area include; hard and soft corals, sponges, seagrass and mobile invertebrates such as urchins, sea cucumbers, starfish and conch. Detailed Seagrass and Coral Removal and Relocation Plans, as well as a Post-Relocation Monitoring Plan, must be prepared for approval by NEPA. • Alternative mitigations should be proposed when relocation is unlikely to be successful. • Where possible, as little of the natural environment should be relocated or removed. Habitat fragmentation and species displacement should be temporary, with the placement of silt screens, construction materials and equipment as well as general human activity in the area. • Structures placed on the seafloor may cause habitat fragmentation and displace some species, however they may also serve to add ecological volume, providing substrate for organisms to settle and colonize and eventually may serve some ecosystem functions. • Any temporary floating structures and /or vessels should be placed in areas with less sensitive species where possible. Floating structures anchored or moored over seagrass beds or coral colonies should not be left for prolonged time periods as the resulting shading effects may cause deterioration in overall health of the seagrass bed and coral colonies
Fish and Invertebrates	Temporary loss/displacement of fish habitat Clogging of gills from excess, prolonged sedimentation Reduction in food supply as a result of decreased water quality and change in plankton composition	• During construction, the project site should include sediment control measures such as turbidity barriers/silt screens and should be erected around the entire work area to prevent the dispersion of sediments and contaminants throughout the water column. These should be placed so as to reduce/contain the resultant sediment plume during the activities. Construction activities should only continue when these barriers are fully operational, that is; placed correctly; calm to moderate sea conditions; without damage. These barriers are particularly important when operations occur near or may influence sensitive ecosystems and species such as coral reefs and seagrass beds and or filter feeding organisms and fish. • Weekly monitoring of water quality parameters such as temperature, salinity, pH, Dissolved Oxygen, light irradiance, turbidity and Total Suspended Solids (TSS) in and around the project area should be conducted during construction. • Conduct sediment dispersal calculation rates on coral reefs and seagrass beds within 200 meters of the proposed villas and at control stations, on a monthly basis, for comparison to background levels. Pre-construction sedimentation rates should therefore also be conducted and used as a baseline for comparison. • All activities should be limited to the minimal working area, and as such reducing the extent of the footprint. No activities and or placement of anchors or materials should be done placed outside the approved area.
Sea Turtles	Temporary disturbance/displacement from construction activity, lights and noise	• Attempts should be made to schedule the majority of the beach works (breakwaters, groynes, nourishment etc.) outside of turtle nesting season (May – October). • All staff and workers should be sensitized to the all sensitive ecosystems and species in the area, in particular turtles. The site should be inspected daily for any signs of turtle activity. If a nest is suspected or found, all activity nearby should stop until an expert can determine if there is a nest and how to relocate the eggs. • The stakeholders, proponents and the NEPA should develop clear lines of reporting and communication in the event that action needs to be taken. • Silt screens should be used to prevent sedimentation but should be removed promptly along with any other construction debris and material upon completion. • Night-time activities should be limited or avoided when possible. No lights should be pointed out to sea. This may confusion and disorientation of turtles or any other species that maybe affected by lunar activity. • Fixtures in direct line-of-sight from the beach should be shielded down-light only fixtures or recessed fixtures having low wattage "bug" type bulbs and non-reflective interior surfaces.

CATEGORY		POTENTIAL IMPACT	RECOMMENDED MITIGATION
			• Fixtures mounted as low in elevation as possible through use of low-mounted wall fixtures, low bollards and ground level fixtures. • Floodlights, up-lights or spotlights for decorative and accent purposes that are directly visible from the beach or which indirectly or cumulatively illuminate the beach shall not be used. • For high intensity lighting applications such as providing security and similar applications shielded low-pressure sodium vapour lamps and fixtures shall be used
Human/Social	Employment	Creation of direct, indirect and induced jobs	No mitigation required
	Solid Waste	Increased generation of solid waste	• Skips and bins should be strategically placed within the campsite and construction site. • The skips and bins at the construction campsite should be adequately designed and covered to prevent access by vermin and minimise odour. • The skips and bins at both the construction campsite and construction site should be emptied regularly to prevent overfilling. • Disposal of the contents of the skips and bins should be done at an approved disposal site - Retirement Disposal Facility, St. James.
	Wastewater	Contamination of marine environment from accidental spillage of portable toilets	• Provision and maintenance of portable sanitary conveniences for the construction workers for control of sewage waste by a licenced contractor. A ratio of approximately 25 workers per chemical toilet should be used. • Showers should be provided for the workers. • Portable toilets should be located at a distance from the shoreline to avoid discharge into the marine environment in the event of accidental spillage.
	Vending and Hygiene	Illnesses resulting from improper food handling practices Negative visual effect on area	• Provision of adequate supply of potable water. • The monitoring of the various 'cook shops" by public health authorities and the construction management team, to ensure proper hygiene is being followed. • The provision of areas to adequately wash hands and utensils.
	Transportation and Traffic	Traffic travelling along the through lanes to Negril and Lucea are not significantly affected during the construction phases Vehicles entering and exiting the hotel property are expected to experience tolerable delays for short periods	No mitigation required
		Effect of overweight vehicles on road surface	In order to alleviate road damages, all the weight of trucks carrying construction materials must be determined by scale and overloading is strictly prohibited as per NWA weight limit requirements.
		General Traffic Management	• Construction traffic entering or leaving the site will be scheduled for off peak hours to minimize additional congestion at the intersections and/or disruptions in the regular traffic flow. • Construction next to the highway will be scheduled for off peak hours and adequate traffic management procedures/methods will be put in place. • Adequate covering up of the works to minimize danger to passing traffic. • Erection of signs ahead of the works warning motorists of the construction ahead.
		Accident potential south of Access Road 1	Increased signage in the area to remind motorists to reduce their speed as they approach each intersection.
	Occupational Health and Safety	Potential for accidental injury of construction workers Fugitive Dust effect on health of construction workers	• The provision of lifelines, personal safety nets or safety belts and scaffolding for the construction workers (if necessary) • Ensuring that workers wear personal protective equipment (hard hats, reflective vests, safety shoes, eye protection etc.) • Where unavoidable, construction workers working in dusty areas should be provided and fitted with N95 respirators. • Areas should be dampened every 4-6 hours or within reason to prevent a dust nuisance and on hotter days, this frequency should be increased. • There should be onsite first aid kits and arrangement for a local nurse and/or doctor to be on call for the construction site. • Make prior arrangements with local health care facilities such as health centres or the Noel Holmes Hospital in Lucea to accommodate any eventualities

CATEGORY		POTENTIAL IMPACT	RECOMMENDED MITIGATION
			• Make prior arrangements with the Lucea Fire Station and Green Island Police Station to accommodate any eventualities. • Material Safety Data Sheets (MSDS) should be stored onsite. • A lead person should be identified and appointed to be responsible for emergencies occurring on the site. This person should be clearly identified to the construction workers. • Trench Excavation ○ A trench 1.2m or more in depth must have a means of egress (ladders/ stairways/ramps) and should be located at 8m intervals. ○ Excavated materials must be stored 0.6m or more from the open trench (not to be measured from the crown of the spoil). ○ Spoil should be placed so that the channels rainwater and other runoff water away from the excavation. ○ Take precautions regarding Tension Cracks ▪ Tension cracks usually form at a horizontal distance of 0.5 to 0.75 times the depth of the trench. ▪ Sliding or sloughing may occur as a result of tension cracks
	Aesthetics	Decreased aesthetic appeal of construction site activities	Good housekeeping activities and adherence to other mitigative measures.
		Trucks leaving the construction site have the potential to deposit marl and mud onto the main road, making the main road aesthetically unappealing.	• An area of gravel should be placed on site (just before exiting onto the main road) to help remove mud/marl from truck wheels. • A wheel wash area on site (just before exiting onto the main road) should be implemented to rid wheels of as much mud/marl as possible
	Historical Artefacts	No historical, archaeological features were uncovered. No artefacts were recovered.	No mitigation required

Table 9-2 Summary Table for Potential Impacts and Mitigation during Operations

CATEGORY		POTENTIAL IMPACT	RECOMMENDED MITIGATION
Physical	Drainage and Hydrology	Increased flood levels within mangrove forest	• Enhancement to the mangrove system is proposed by introducing several culvert openings throughout the existing road network within the mangrove. This would promote more free movement of water through the entire mangrove forest, which will improve the storage capacity and provide water to areas currently deprived of water. • Several ponds are proposed within the barren elevated areas in the midst of the mangrove to alleviate any flooding impact on adjacent communities. • The proposed drainage concept will allow rainfall runoff to drain freely into the mangrove via ten outfall points. All the outfall points were set at an elevation higher than the projected flood elevation for the 1 in 50-yr storm frequency, with consideration for climate change.
		Flooding of adjacent communities	
		Runoff to drain freely into mangrove forest via ten outfall points	
	Currents	Flushing channel does not significantly change the currents along the project site	No mitigation required
		Flushing channel helps to draw out any pollutant and reduce the concentration with Negro Bay	No mitigation required
	Sediment Transport	Sediment transport regime remained unchanged	No mitigation required
		No significant impact to downdrift shorelines	No mitigation required
Biological	Vegetation	Introduction of invasive alien plant species via landscaping activities can result in their proliferation.	Ensure that plants used for landscaping are native/local species. Exotic/unknown plant species should not be used in landscaping.
	Reef Community	Hard structures (groynes, breakwaters, jetty) will provide of ecological volume and substrate for colonization and recruitment	No mitigation required
	Fish	Hard structures (groynes, breakwaters, jetty) will act as Fish Aggregation Devices (FADs)	No mitigation required
	Sea Turtles	Alteration of food source from seagrass bed modification	• Artificial lighting should not be placed on the beach. If lights have to be used, turtle-friendly lighting and light positioning (if any) should be used. • Hotel operators should also educate their guests on sea turtle conservation and the correct actions to take if a sea turtle is observed nesting on the beach • Development of a Sea Turtle Monitoring programme which would include tagging and hatchling release.
		Hard structures act as deterrent from going ashore to nest	
		Noise and lighting act as deterrent from going ashore to nest	
Natural Hazards	Swell Wave Climate	Wave climate unchanged by breakwaters located at Hotel 1	No mitigation required
		Wave climate reduced by breakwaters located at Hotel 4	No mitigation required
		Swimming areas created at Hotels 2 and 3 have reduced wave energy	No mitigation required
	Hurricane Waves and Storm Surge	Storm surge reduced by breakwaters located at Hotel 4	No mitigation required
		Flooding of hotel blocks by storm surge	Adhere to recommended floor level heights
	Climate Change	Flooding from increased rainfall intensity	Structures and buildings were designed for higher than standard return events
		Siltation of drainage systems and coastal areas	Drainage plans are fortified with silt traps to reduce the siltation impact to the coastal areas. Flushing channel to increase the circulation of the area overtime
		Sea level rise and resulting increased storm surge	The floor levels for the property were set to be above the 100-year storm surge events.
		Structural Fatigue from increased storm surge	All rock structures were also designed to withstand stronger waves that come from more intensive storms.
Human/Social	Employment	Creation of direct, indirect and induced jobs	No mitigation required
	Water supply and consumption	Burdening of the water supply in the area in the event of drought conditions.	It is recommended that various storage and conversation measures be put in place at the hotel such as: • Low flow fixtures • Dual flush toilets • Faucets fitted with aerators • Electronic spigots and flush valves Other operational strategies for reduction of water consumption include: • Do not leave the tap running while cleaning, using buckets for holding water instead • Make sure that all faucets do not leak and are in good repair • Report immediately any leaking or dripping faucet or toilet • Give guests the option of changing linen and towels every two or three days • Use only the minimum required amount of detergent in the laundry

CATEGORY		POTENTIAL IMPACT	RECOMMENDED MITIGATION
			• Reuse rinse-water in the first cycle of washing of the next load • Separate the laundry's hot-water system from the guest room hotel-water system if possible • Hotel guests can be given politely written cards as to how to conserve water in their bathrooms, for example to, shut off water during tooth brushing, shaving, and other unnecessary period • Keep utility bills to track the consumption of water • Purchase and use water-saving equipment always • Establish an effective employee training program about water conservation • Wash food products in buckets, bowls or containers • Use dishwasher with sufficient loads • Make regular inspections of dishwasher pumps for water leakage • Do not use water to defrost or thaw frozen food products, defrost in refrigerator • Recover waste pool water for reuse • Use wastewater effluent for irrigation
	Tourism	Improvement of the tourism product of the country	No mitigation required

	Emergency Response	Workers and guests may become ill or have accidents. In addition, disasters such as earthquakes, floods, storm surge and fires are real possibilities.	• Have first aid kits located in various sections of the hotel.
			• Design and implement an emergency response plan.
			• Staff should be trained in CPR and basic first aid.
			• Arrange for mutual assistance and make prior arrangements with:
			  ○ Health care facilities, Noel Holmes Hospital and associated doctors and nurses to accommodate any eventualities.
			  ○ Arrange with other health practitioners to be on call or have an in-house physician/nurse.
			  ○ Lucea Fire Station (additional firefighting units and a fire boat)
			  ○ Green Island Police Station (police personnel in addition to the Tourism Courtesy Corp Officers)

	Solid Waste	Increased solid waste generation	• Provision of solid waste storage bins and skips. • Provision of adequately designed bins and skips to prevent access by vermin. • Monitor beach garbage. • Contracting a private contractor to collect solid waste in a timely fashion to prevent a build-up. • Ensure that the solid waste collected is disposed in an approved disposal site - Retirement Disposal Facility, St. James.
	Transportation and Traffic	Traffic travelling along the main road are not significantly affected	No mitigation required
		Vehicles entering and exiting the hotel property are expected to experience tolerable delays for short periods	The assessment revealed that it is not necessary for either intersection to be signalized as the volume of traffic does not warrant the installation. However, the implementation of acceleration and deceleration lanes may decrease the frequency of accidents in the area.
		A Traffic light will increase the delay for vehicles, thus decreasing the Level of Service	

Table 9-3 Summary Table for Potential Impacts and Mitigation during Construction of Overwater Searooms

<table>
<tr><th colspan="2">CATEGORY</th><th>POTENTIAL IMPACT</th><th>RECOMMENDED MITIGATION</th></tr>
<tr><td rowspan="4">Physical</td><td rowspan="3">Water Quality</td><td>Increased TSS/turbidity in water during construction activities (piling installation etc.)</td><td rowspan="2">• During construction, the project site should include sediment control measures such as turbidity barriers/silt screens and should be erected around the entire work area to prevent the dispersion of sediments and contaminants throughout the water column.
• Weekly monitoring of water quality parameters such as temperature, salinity, pH, Dissolved Oxygen, light irradiance, turbidity and Total Suspended Solids (TSS) in and around the project area should be conducted during construction for the first 3 months. Monitoring can be conducted fortnightly thereafter.
• Conduct sediment dispersal calculation rates on coral reefs and seagrass beds within 200 meters of the proposed overwater villas and at control stations, on a monthly basis, for comparison to background levels and pre-construction sedimentation rates.</td></tr>
<tr><td>Increased TSS/turbidity in water from temporary boulder construction pad</td></tr>
<tr><td>Stagnation of water behind the boulder construction pad</td><td>Culverts will be constructed through the construction pad to allow for exchange of water.</td></tr>
<tr><td>Noise</td><td>Noise impact on surrounding residential and educational communities and construction workers</td><td>• Use equipment that has low noise emissions as stated by the manufacturers.
• Use equipment that is properly fitted with noise reduction devices such as mufflers.
• Operate noise-generating equipment during regular working hours (e.g. 7 am – 7 pm) to reduce the potential of creating a noise nuisance during the night.
• Construction workers operating equipment that generates noise should be equipped with noise protection. A guide is workers operating equipment generating noise of ≥ 80 dBA (decibels) continuously for 8 hours or more should use earmuffs. Workers experiencing prolonged noise levels 70 - 80 dBA should wear earplugs.</td></tr>
<tr><td rowspan="6">Biological</td><td rowspan="4">Seagrass</td><td>Temporary shading by floating structures/vessels</td><td rowspan="6">• During construction, the project site should include sediment control measures such as turbidity barriers/silt screens and should be erected around the entire work area to prevent the dispersion of sediments and contaminants throughout the water column. These should be placed so as to reduce/contain the resultant sediment plume during the activities. Construction activities should only continue when these barriers are fully operational, that is; placed correctly; calm to moderate sea conditions; without damage. These barriers are particularly important when operations occur near or may influence sensitive ecosystems and species such as coral reefs and seagrass beds and or filter feeding organisms and fish.
• Weekly monitoring of water quality parameters such as temperature, salinity, pH, Dissolved Oxygen, light irradiance and turbidity in and around the project area, for the first 3 months during construction. Monitoring can be conducted fortnightly thereafter.
• Conduct sediment dispersal calculation rates on coral reefs and seagrass beds within 200 meters of the proposed villas and at control stations, on a monthly basis, for comparison to background levels. Pre-construction sedimentation rates should therefore also be conducted and used as a baseline for comparison.
• All activities should be limited to the minimal working area, and as such reducing the extent of the footprint. No activities and or placement of anchors or materials should be done placed outside the approved area.
• Relocation of sensitive species should be done if; they are suitable for relocation (that is suitable substrate, health and over all viability), those species fall within the potential impact area; and if mobile invertebrates are in or around the potential impact area. Sensitive organisms and systems in and outside the impact area include; hard and soft corals, sponges, seagrass and mobile invertebrates such as urchins, sea cucumbers, starfish and conch. Detailed Seagrass and Coral Removal and Relocation Plans, as well as a Post-Relocation Monitoring Plan, must be prepared for approval by NEPA.
• Alternative mitigations should be proposed when relocation is unlikely to be successful.
• Where possible, as little of the natural environment should be relocated or removed. Habitat fragmentation and species displacement should be temporary, with the placement of silt screens, construction materials and equipment as well as general human activity in the area.
• Structures placed on the seafloor may cause habitat fragmentation and displace some species, however they may also serve to add ecological volume, providing substrate for organisms to settle and colonize and eventually may serve some ecosystem functions.</td></tr>
<tr><td>Smothering of seagrass blades and epiphytes from sedimentation</td></tr>
<tr><td>Reduced light penetration and resulting decrease in photosynthesis</td></tr>
<tr><td>Mechanical abrasion from moorings and anchors</td></tr>
<tr><td rowspan="2">Coral and sessile fauna</td><td>Smothering of sensitive nearby coral including Acropora palmata and reduced light from sedimentation</td></tr>
<tr><td>Impaired filter feeding and photosynthesis from prolonged sedimentation</td></tr>
</table>

CATEGORY		POTENTIAL IMPACT	RECOMMENDED MITIGATION
			• Any temporary floating structures and /or vessels should be placed in areas with less sensitive species where possible. Floating structures anchored or moored over seagrass beds or coral colonies should not be left for prolonged time periods as the resulting shading effects may cause deterioration in overall health of the seagrass bed and coral colonies
	Fish	Temporary loss/displacement of fish habitat Clogging of gills from excess, prolonged sedimentation Reduction in food supply as a result of decreased water quality and change in plankton composition	• During construction, the project site should include sediment control measures such as turbidity barriers/silt screens and should be erected around the entire work area to prevent the dispersion of sediments and contaminants throughout the water column. These should be placed so as to reduce/contain the resultant sediment plume during the activities. Construction activities should only continue when these barriers are fully operational, that is; placed correctly; calm to moderate sea conditions; without damage. These barriers are particularly important when operations occur near or may influence sensitive ecosystems and species such as coral reefs and seagrass beds and or filter feeding organisms and fish. • Weekly monitoring of water quality parameters such as temperature, salinity, pH, Dissolved Oxygen, light irradiance, turbidity and Total Suspended Solids (TSS) in and around the project area should be conducted during construction for the first 3 months, then fortnightly thereafter • Conduct sediment dispersal calculation rates on coral reefs and seagrass beds within 200 meters of the proposed villas and at control stations, on a monthly basis, for comparison to background levels. Pre-construction sedimentation rates should therefore also be conducted and used as a baseline for comparison. • All activities should be limited to the minimal working area, and as such reducing the extent of the footprint. No activities and or placement of anchors or materials should be done placed outside the approved area.
	Sea Turtles	Temporary disturbance/displacement from construction activity, lights and noise	• Attempts should be made to schedule the majority of the construction period outside of turtle nesting season (May – October). • All staff and workers should be sensitized to the all sensitive ecosystems and species in the area, in particular turtles. The site should be inspected daily for any signs of turtle activity. If a nest is suspected or found, all activity nearby should stop until an expert can determine if there is a nest and how to relocate the eggs. • The stakeholders, proponents and the NEPA should develop clear lines of reporting and communication in the event that action needs to be taken. • Silt screens should be used to prevent sedimentation but should be removed promptly along with any other construction debris and material upon completion. • Night-time activities should be limited or avoided when possible. No lights should be pointed out to sea confusion and disorientation of turtles or any other species that maybe affected by lunar activity. • Fixtures in direct line-of-sight from the beach should be shielded down-light only fixtures or recessed fixtures having low wattage "bug" type bulbs and non-reflective interior surfaces. • Fixtures mounted as low in elevation as possible through use of low-mounted wall fixtures, low bollards and ground level fixtures. • Floodlights, up-lights or spotlights for decorative and accent purposes that are directly visible from the beach or which indirectly or cumulatively illuminate the beach shall not be used. • For high intensity lighting applications such as providing security and similar applications shielded low-pressure sodium vapour lamps and fixtures shall be used.
Human/Social	Maritime Traffic	Fishing and other maritime activities affected by construction process Accident potential due to presence of maritime vessels, structures and equipment at sea	The use of highly visible marker buoys demarcating an exclusion zone should be used to keep out other marine traffic and fishers from the work area to prevent potential accidents
	Health and Safety	Occupational Health and safety of workers (accident potential)	• A lead person should be identified and appointed to be responsible for emergencies occurring on the site. This person should be clearly identified to the construction workers. • At least two (2) certified lifeguards should be hired and be on site during work hours in the event of potential accidental drowning. • The construction management team should have onsite first aid kits and make arrangements for the nurse and doctor at Noel Holmes Hospital to be on call for the construction site. Prior arrangements should be made with health care facilities/clinics to accommodate any eventualities. • Make prior arrangements with the Lucea Fire Station and Green Island Police Station to accommodate any eventualities.

	CATEGORY	POTENTIAL IMPACT	RECOMMENDED MITIGATION
			• Material Safety Data Sheets (MSDS) should be stored onsite
	Aesthetics	Decreased aesthetic appeal	Good housekeeping activities and adherence to other mitigative measures especially with regard to potential marine water quality contamination.

Table 9-4 Summary Table for Potential Impacts and Mitigation during Operation of Overwater Searooms

CATEGORY		POTENTIAL IMPACT	RECOMMENDED MITIGATION
Biological	Reef and Seagrass Communities	Searoom pilings provide ecological volume for coral colonization and recruitment	No mitigation required
	Fish	Searoom pilings and shaded areas will act as Fish Aggregation Devices (FADs)	No mitigation required
	Sea Turtles	Alteration of food source from seagrass bed modification Searoom structures/pilings act as deterrent from going ashore to nest Noise and lighting act as deterrent from going ashore to nest	• Turtle-friendly lighting and light positioning (if any) should also be placed on the searooms • Hotel operators should also educate their guests on sea turtle conservation and the correct actions to take if a sea turtle is observed nesting on the beach • Development of a Sea Turtle Monitoring programme which would include tagging and hatchling release.
Natural Hazards	Climate Change	Design calculations for the proposed concepts included projections for sea level rise to the year 2100	No mitigation required
	Storm Surge	Potential Damage of searooms by storm surge	Adhere to recommended floor level heights
	Hurricane Wave Climate	Natural Reef system aids in reduction of wave energy	No mitigation required
Human/Social	Maritime Traffic	Maritime activities affected by presence of searooms Accident potential due to possibility of collision with searoom structures	• After construction is completed, permanent highly visible marker buoys should be placed at strategic points around the overwater rooms. • Turtle-friendly lighting and light positioning should also be placed on the searooms so that they are visible to marine vessels at nighttime.
	Aesthetics	Improvement of the aesthetic appeal of the hotel	No mitigation required
	Emergency Response	Workers and guests may become ill or have accidents. In addition, disasters such as storm surge and fires are real possibilities.	• Have first aid kits located in various sections of the hotel. • Design and implement an emergency response plan. • Staff should be trained in CPR and basic first aid. • Arrange mutual assistance and make prior arrangements with: ○ Health care facilities, Noel Holmes Hospital and associated doctors and nurses to accommodate any eventualities. ○ Arrange with other health practitioners to be on call or have an in-house physician/nurse. ○ Lucea Fire Station (fire boat) ○ Green Island Police Station (Marine police to conduct patrols in the vicinity of the overwater searooms). This may also be conducted by contracted private security.
	Tourism	Improvement of the tourism product of both the hotel and the country	No mitigation required

10.0 IDENTIFICATION AND ANALYSIS OF ALTERNATIVES

The discussion and analysis of alternatives in Environmental Impact Assessments should consider other practicable strategies that will promote the elimination of negative environmental impacts identified. This section is a requirement of the National and Environment and Planning Agency (NEPA) and is critical in consideration of the ideal development with minimal environmental disturbance.

The following project alternatives have been identified and are discussed in further detail below:

- Alternative 1 - The "No-Action" Alternative
- Alternative 2 - The Project as Proposed in the EIA
- Alternative 3 – The Project as Proposed in the EIA, but without the sea rooms
- Alternative 4 – The Project as Proposed in the EIA, but without Hotel Block 3
- Alternative 5 - The Project as Proposed in the EIA, but with a reduced mangrove boardwalk footprint

10.1 ALTERNATIVE 1 – THE "NO-ACTION" ALTERNATIVE

Under the No-Action Alternative, the existing property and mangrove forest at Cove would remain as is.

The **advantages** of the No-Action Alternative include:

Physical

- No nuisance from construction activities (dust, noise etc.).
- No increased turbidity/TSS in the marine environment.
- No potential spillage of fuel/oil/lubricants in the marine environment.

Biological

- Mangrove forest and associated fauna remain undisturbed
- No increased turbidity/TSS or oil and grease in the mangrove forest.
- No permanent seagrass habitat loss
- No smothering and sedimentation of seagrass, coral and associated macrofauna
- No disturbance of possible turtle nesting by obstacles in water, increased noise and lighting.

Human/Social

- Maritime activities will not be affected by the physical presence of the searooms
- No increased maritime accident potential in the form of vessel collision with searoom structures
- No increased water usage and solid waste generation.

The **disadvantages** of the No-Action Alternative include:

Biological

- No provision of added ecological volume from groynes, breakwaters and searoom pilings resulting in more available space for recruitment and colonization of hard coral and other sessile fauna.
- No creation of Fish Aggregation Devices (FADs) by the presence of groynes, breakwaters and the pilings and the shaded areas provided by the searoom structures.

Human/Social

- No additional economic benefits to the community and economy.
- No increased employment and creation of indirect and induced job opportunities
- No broadening of the tourism client base and overall diversified and enhanced Jamaican tourism product
- No further increase the room offerings of the island

10.2 ALTERNATIVE 2 – THE PROJECT AS PROPOSED IN THE EIA

Princess Hotels and Resorts Limited has acquired approximately 73 hectares (180 acres) of land in Green Island, Hanover and is desirous of constructing a 2037-room eco-resort on approximately 34 hectares (≈ 84 acres) of it. This will consist of a combination of four (4) separate hotel blocks and fourteen (14) overwater searooms.

The biological, physical and socioeconomic impacts and mitigation measures for the project as proposed are discussed in detail throughout this report.

The **advantages** to this alternative include:

Biological

- Provision of added ecological volume from groynes, breakwaters and searoom pilings resulting in more available space for recruitment and colonization of hard coral and other sessile fauna.
- Creation of Fish Aggregation Devices (FADs) by the presence of groynes, breakwaters and the pilings and the shaded areas provided by the searoom structures.

Human/Social

- Additional economic benefits to the community and economy.
- Increased employment and creation of indirect and induced job opportunities
- Broadening of the tourism client base and overall diversified and enhanced Jamaican tourism product
- Further increase the room offerings of the island

The **disadvantages** to this alternative include:

Physical

- Noise and dust nuisance to surrounding residential communities from construction activities
- Increased turbidity/TSS in the marine environment.
- Potential spillage of fuel/oil/lubricants in the marine environment.

Biological

- Loss of Mangrove forest and disturbance of associated fauna within
- Increased turbidity/TSS and/or oil and grease in the mangrove forest.as a result of drainage
- Seagrass habitat loss
- Smothering and sedimentation of seagrass, coral and associated macrofauna
- Disturbance of possible turtle nesting by obstacles in water, increased noise and lighting.

Human/Social

- Maritime activities affected by the physical presence of the searooms
- Increased maritime accident potential in the form of vessel collision with searoom structures
- Increased water usage and solid waste generation.

10.3 ALTERNATIVE 3 – THE PROJECT AS PROPOSED IN THE EIA, BUT WITHOUT THE SEA ROOMS

The project as proposed in the EIA involves a combination of four (4) separate hotel blocks and fourteen (14) overwater searooms. Alternative 3 would opt to omit the overwater sea rooms, leaving only the four (4) Hotel blocks.

Advantages and disadvantages would be similar to Alternative 2 – The Project as Proposed in the EIA, however, there are a few differences that would occur. These are:

<u>Advantages:</u>

- No seagrass habitat loss in this area as a result of the temporary boulder construction pad and other activities as well as no shading of seagrass from overwater searooms. The total seagrass area that would remain unaffected is **5,126.18 m^2.**
- No sedimentation in water column in this area as a result of temporary boulder construction pad and other activities
- No sedimentation of nearby coral communities
- No potential for maritime accidents
- Nesting sea turtles will not be deterred by added lighting, noise and pilings

<u>Disadvantages:</u>

- No provision of additional ecological volume from searoom pilings to aid in coral recruitment and colonization
- Decreased tourism client base and less diversified and enhanced Jamaican tourism product
- Decreased revenue for hotel

10.4 ALTERNATIVE 4 – THE PROJECT AS PROPOSED IN THE EIA, BUT WITHOUT HOTEL BLOCK 3

The project as proposed in the EIA involves a combination of four (4) separate hotel blocks and fourteen (14) overwater searooms. Alternative 4 would opt to omit Hotel Block 3 and its associated infrastructure and amenities. This is because Hotel 3 is located in the vicinity of the Mangrove Transect 6, which had some of the most mature (tallest and some of the widest girth) trees in the entire survey. This location also showed the highest depth of standing water, in an almost exclusively black mangrove dominated forest area.

Advantages and disadvantages would be similar to Alternative 2 – The Project as Proposed in the EIA, however, there are a few differences that would occur. These are:

Advantages:

- Tallest black mangrove trees in the area would remain undisturbed.
- This area proves to be critical to site drainage and hydrology as it had the highest depth of standing water of all the other areas surveyed.

Disadvantages:

- Decreased number of room offerings

10.5 ALTERNATIVE 5 – THE PROJECT AS PROPOSED IN THE EIA, BUT WITH A LONGER BOARDWALK

The project as proposed in the EIA involves approximately 2.163 kilometres of boardwalk through the mangrove forest for eco-tour purposes. The boardwalk layout in the vicinity of Hotel 1 will remain as is. However, Alternative 5 would opt to increase the number of boardwalks present toward the south of the project property in the vicinity of Hotel 4, thus increasing the overall boardwalk length to 2.949 kilometres.

Advantages and disadvantages would be similar to Alternative 2 – The Project as Proposed in the EIA, however, there are a few differences that would occur. These are:

Advantage:

- Additional areas for guests to traverse the mangrove forest

Disadvantage:

- 1,572 m^2 of additional mangrove would be lost as a result of the increased boardwalk footprint.

Figure 10-1 displays the existing boardwalk layout plan according to the project description, while Figure 10-2 displays the revised boardwalk layout plan according to Alternative 5.

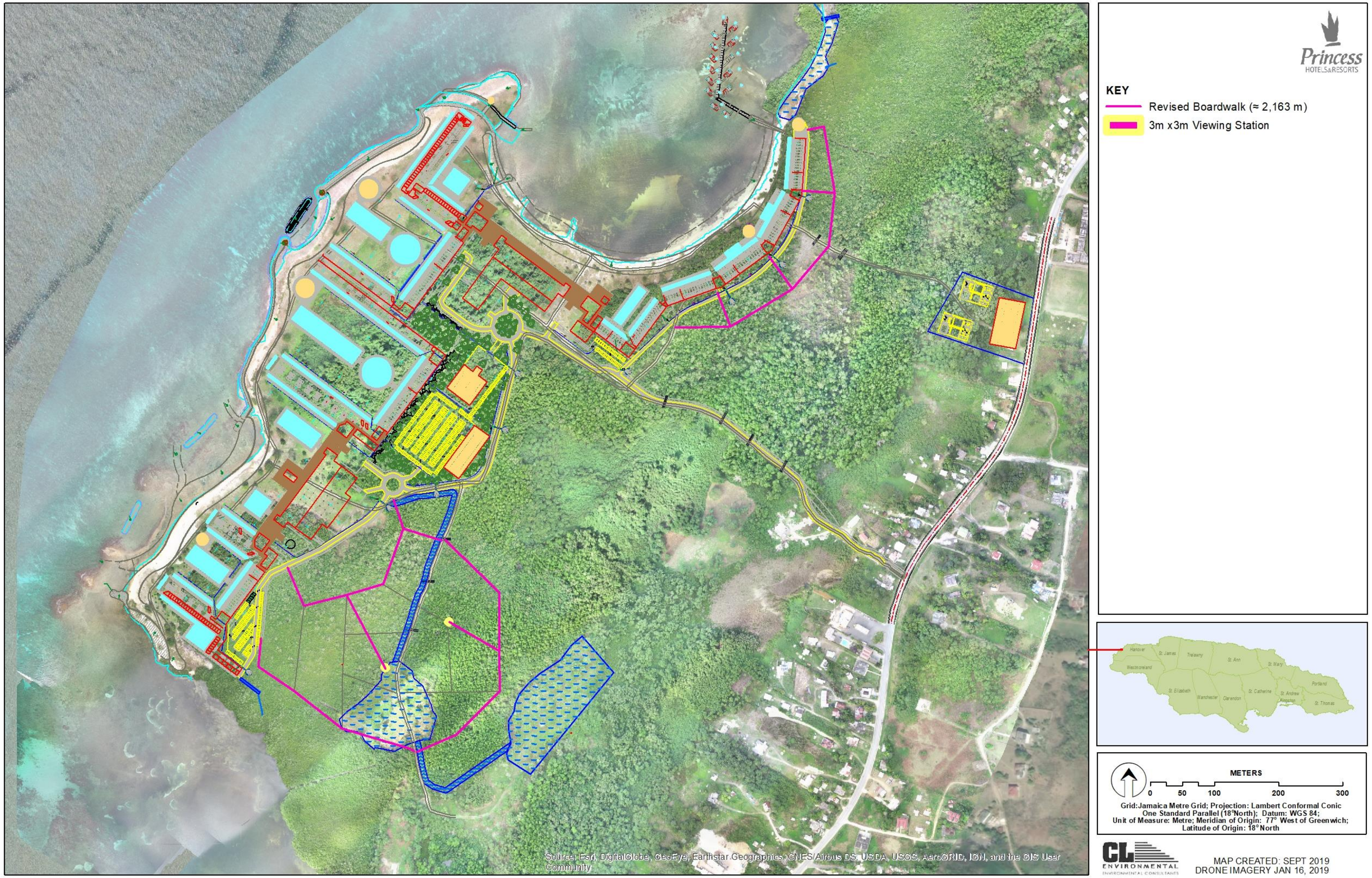


Figure 10-1 Existing boardwalk plan according to project description

Figure 10-2 Alternate boardwalk plan according to Alternative 5

10.6 THE PREFERRED ALTERNATIVE

Of the alternatives presented in previous sections, **Alternative 2 – The Project a Proposed in the EIA,** is the preferred alternative. Indeed, the adverse potential impacts must be mitigated, and the various management and monitoring programmes adhered to during all project phases.

11.0 ENVIRONMENTAL MANAGEMENT AND MONITORING PROGRAMME

An Environmental Management System (EMS) is an important tool which can be used to assist operations managers in meeting current and future environmental requirements and challenges. It can be used to measure a company's operations against environmental performance indicators, thereby helping the company to reach its environmental targets. A good management system will integrate environmental management into a company's daily operations, long-term planning and other quality assurance systems.

It is therefore recommended that several parameters be monitored before, during and after the project implementation to record any negative construction impacts and to propose corrective or mitigation measures. The suggested parameters include but are not limited to the following:

1) Water Quality to include but not be limited to:
    a. Nitrates
    b. Phosphates
    c. BOD
    d. Fats, oil and grease
    e. pH
    f. TSS
    g. Turbidity
    h. TDS
    i. Faecal Coliform
2) Noise
3) Coral and Fisheries
4) Seagrass
5) Traffic
6) Maritime Operations
7) Solid Waste Generation and Disposal
8) Sewage Generation and Disposal
9) Equipment Maintenance
10) Health and Safety

11.1 DRAFT MANGROVE, CORAL AND SEAGRASS MANAGEMENT PLANS

While the Environmental Monitoring Plan (Section 11.2) entails coral and seagrass related monitoring practices during construction, the draft plans below give more specifics with regard to coral and seagrass monitoring and management, as well as replanted mangrove (mangrove afforestation) monitoring and management.

11.1.1 Mangrove Management Plan

The Mangrove Management Plan will include a combination of existing and replanted mangrove survey/monitoring exercises and water quality monitoring before, during and after construction. The activities will be conducted by qualified and trained mangrove ecologists.

Existing Mangrove Surveys

Belt transects will be used to assess the existing mangrove community and record the following features:

- Tree species and numbers within sample area
- Tree heights(m) for up to 10 of each species present
- Diameter at breast height (DBH)in cm, for up to 10 of each species present
- Density of mangrove seedlings within 1 m^2.
- Visible fauna

Water level data loggers will also be deployed on the forest floor, secured in place on the substrate surface to record water temperature and pressure of water above the device (in PSI), which may be converted into depth. This provides evidence on the influence of water on the forest over a specified time.

Other observations to be made included: overall health and appearance and signs of human disturbance. The location of each transect will be recorded using a GPS.

Replanted Mangrove Sapling Surveys

Mangrove saplings will be sourced from a mangrove nursery and planted in designated and suitable rehabilitation sites by qualified mangrove ecologists. Tidal channels for water flow into the rehabilitation site will be constructed if needed. Parameters to be monitored for each species planted will include percentage survival of planted saplings, number of seedlings dead/alive, height of saplings, number of leaves on saplings, number of pneumatophores and number of prop roots.

Water Quality Monitoring

Temperature, pH, salinity, conductivity, dissolved oxygen, turbidity, total dissolved solids, nitrate and phosphate and TPH will be measured *in situ* using a Hydrolab DataSonde DS-5 multiprobe and laboratory analysis at the mangrove survey/monitoring locations. The results of the data collected will be compared with National Environment and Planning Agency (NEPA) water quality standards.

Phasing and Monitoring Frequency

The Mangrove Monitoring Programme will be implemented during three (3) phases:

- Pre-construction (to serve as a baseline)
- During construction period

- Post-construction (5 years assuming replanting/afforestation)

The proposed frequency of monitoring is outlined below based on the various phases.

Pre-Construction (baseline)

- Mangrove belt transect surveys throughout various sections of the property.
- Three (3) water quality sampling runs

During Construction

- Visual/roving observations for drainage of oil, lubricants and excess sediments into mangrove swamp
- Monthly water quality monitoring.

Post-Construction

- Quarterly replanted mangrove monitoring for the first 2 years, then biannual thereafter. Water quality monitoring is also to be conducted alongside the replanted mangrove monitoring, at each relocation site, using the same frequency.

Mangrove Replanting Works

Any mangrove replanting works to be conducted as a mitigation measure will be done in accordance with the NEPA Mangrove Restoration and Monitoring protocols (Table 11-1 and Table 11-2).

Table 11-1 NEPA-appointed Mangrove Restoration Summary Form – Weekly log of Restoration Activity

<table>
<tr><th></th><th></th><th></th><th></th></tr>
<tr><td rowspan="2">Persons Conducting Restoration:

Authorized by:</td><td colspan="2">GPS Location of Restoration Site/s: (State format):</td><td>Date of Restoration:</td></tr>
<tr><td colspan="2">Site no:</td><td>Week No:</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4">Brief summary of weekly restoration activities as implemented:</td></tr>
<tr><td colspan="2">No. of Tidal Channels Constructed or Remediated:</td><td colspan="2">Grids Planted per week (This should be accompanied by gridded map of the restoration site):</td></tr>
</table>

Average Depth of Tidal Channels:	**No. of Grids**	**GPS Location of Grids**
Total No of Seedlings Planted: () **Source:** *Nursery () Wild Stock ( )* **Species:** *Red: () Black: () White: ( ) Button: ( )*		
Comments and Observations:		

Table 11-2 NEPA-appointed Replanted Mangrove Monitoring Summary Form (post-relocation monitoring)

Persons Conducting Monitoring: Authorized by:	GPS Location of Planting Site/s *(State format)*:	Date of Monitoring: Growth and Survival Trend Graph:
Monitoring Period: *() Time Zero () Time Zero Plus 60 days () Time Zero Plus 180 days () Time Zero Plus 365 days* *() Year 1 Plus 180 days () Year 1 Plus 365 days () Year 2 Plus 180days () Year 2 Plus 365days* *() Year 3 Plus 180 days () Year 3 Plus 365days () Year 4 Plus180 days () Year 4 Plus 365days*		
Percentage Survival of Planted Seedlings: *Red () Black ()* *White () Button ()*	Average No. of Seedlings: *Live () Dead ()*	Average Height of Planted Seedlings: *Red () Black ()* *White () Button ()*
Average No. of Volunteer Seedlings: *Red () Black ()* *White () Button ()*	Species Composition of Planted Seedlings *(Percentage)* *Red () Black () White ( ) Button( )*	
Average No. of Leaves of Planted Seedlings:	Average No. of pneumatophores:	Average No. of prop roots:
Water Quality: *Temperature:* *Salinity:* *pH:*		

Date and Extent of Remedial Planting *if any (details should be outlined on the remediation monitoring form):*
Comments, Observations, Ecological Trends:

11.1.2 Coral Management Plan

The Coral Management Plan will include a combination of coral monitoring exercises, water quality monitoring and sediment dispersal monitoring, before, during and after construction. The activities will be conducted by qualified and trained marine scientists and SCUBA divers.

Coral Monitoring using Photo-transects

Two (2) monitoring sites will be selected within the project area: One being in shallow water (4 – 6m) and the other in deep water (15 – 20m). Each sample site will have one 100 metre-long transect. The start point of each line will be marked using a GPS and a permanent stake where possible. Compass bearing and depth will also be recorded at the start of each transect. Along each 100m transect line, photos will be taken every 5 meters using a 1 m^2 quadrat, thus totalling 20 photos per transect. A total of 20 m^2 will be assessed for each transect.

The photos will be analysed by using the Coral Point Count with Excel extensions (CPCe) program. This program involves overlaying spatially random points on each image. The benthic features under each of these points are user-identified (e.g. coral species, bleaching/disease incidents, algae, sand, recently killed coral, *Diadema* and other features). Coverage statistics are then able to be calculated and these results displayed in an excel spreadsheet.

Data collected will include but not limited to the following;

1. Percentage Coral Cover;
   - i. Live coral
   - ii. Recently killed coral
   - iii. Dead coral
   - iv. Diseased or bleached coral

2. Percentage Algae Cover

   Where possible Algae will be identified and categorised (fleshy, calcareous and cyanobacteria.

3. General Substrate Composition

   The substrate type will also be identified (sand, pavement, rock etc.)

4. Other Data

Any rare, endangered, commercially important (lobster and conch) and invasive organisms observed will also be noted and photographed, as well as the presence/absence of seagrasses. Any obvious sedimentation, anchor damage, marine debris and other direct impacts will also be recorded.

Roving Coral Reef Surveys

Roving qualitative surveys will be conducted in and around the project area via snorkelling and/or SCUBA diving. Observations and photographs will be taken to include but not be limited to; incidence of coral disease and sedimentation.

Sediment Dispersal

To monitor the potential sediment impact from construction activities on the coral sites, one sediment trap will be deployed at each of the coral monitoring sites, as well as nearby the work area. A total of no less than four (4) sediment traps will be deployed. The sediment traps will be retrieved on a monthly basis, its contents analysed and redeployed to determine the rate of sedimentation ($mg/cm^2/day$) and dispersal patterns over the area. The sediment trap dimensions will be approximately 18" deep with an internal diameter of 3". Traps will be taken to the Mines and Geology Division laboratories for analysis.

The contents of the sediment traps will be filtered through a filter paper, dried and then weighed. The results will be represented in the form of mass of sediment recovered. Using the results retrieved from the laboratory, the unit mass of sediment dispersed per day will be calculated by dividing the mass of sediment recovered by the number of days deployed and the area of the sediment trap opening. Onsite observations will also be included where possible.

Water Quality Monitoring

Temperature, pH, salinity, conductivity, dissolved oxygen, light irradiance, turbidity and total dissolved solids will be measured *in situ* using a Hydrolab DataSonde DS-5 multiprobe at the coral monitoring locations, plus other locations in and around the project area. A total of no less than four (4) water quality monitoring locations will be chosen. Water quality readings will also be taken on the inside and outside of silt screens deployed (during construction). The results of the data collected will be compared with National Environment and Planning Agency (NEPA) marine water quality standards.

Phasing and Monitoring Frequency

The Coral Monitoring Programme will be implemented during three (3) phases:

- Pre-construction (to serve as a baseline)
- During construction period
- Post-construction (1 year)

The proposed frequency of monitoring is outlined below based on the various phases.

Pre-Construction

- One (1) coral monitoring run using phototransects
- One (1) roving coral reef survey
- One (1) sediment dispersal run
- One (1) water quality sampling run

During Construction

- Quarterly (every 3 months) coral monitoring using phototransects until the end of construction
- Monthly roving coral surveys until the end of construction.
- Monthly sediment dispersal runs until the end of construction.
- Weekly water quality monitoring, in particular turbidity monitoring.

Any suspected new or increased incidence of coral disease observed will be immediately reported to NEPA.

Post-Construction

- Biannual coral monitoring using phototransects, for a period of one (1) year.
- Biannual roving coral survey for a period of one (1) year.

Coral Removal and Relocation Works (if any)

Any coral removal and relocation works to be conducted as a mitigation measure will be done in accordance with the NEPA Coral Relocation and Monitoring protocols (Table 11-3 and Table 11-4).

Table 11-3 NEPA-appointed Coral Relocation Summary Form – Weekly log of Relocation Activity

<table>
<tr><td></td><td colspan="2"></td><td></td></tr>
<tr><td rowspan="2">Persons Conducting Relocation:

Authorized by:</td><td colspan="2">GPS Location of Relocation Site/s: (State format):</td><td>Date of Relocation:</td></tr>
<tr><td colspan="2">Site no:</td><td>Week No:</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="2">Average No of Corals Harvested per day (m^2):</td><td colspan="2">No. of Grids Harvested per week:</td></tr>
<tr><td colspan="2">Total No of Corals Harvested Per week (m^2):</td><td colspan="2">No. of Grid Relocated Per week:</td></tr>
<tr><td colspan="2">Total No. of Coral Harvested Per week by species</td><td>Name of Harvested Grid:</td><td>Name of Equivalent Relocation Grid:</td></tr>
</table>

Total Corals Relocated to Date (*This should include all corals relocated up to the end of the week stated above***):**	**Overall weather Conditions:**	
Comments and Observations:		

Table 11-4 NEPA-appointed Coral Monitoring Summary Form (post-relocation monitoring)

Persons Conducting Monitoring: **Authorized by:**	**GPS Location of Planting Site/s** *(State format)***:**	**Date of Monitoring:** **Growth and Survival Trend Graph:**
**Monitoring Period: (***) Time Zero () Time Zero Plus 60 days () Time Zero Plus 180 days () Time Zero Plus 365 days () Year 1 Plus 180 days () Year 1 Plus 365 days () Year 2 Plus 180days () Year 2 Plus 365days () Year 3 Plus 180 days () Year 3 Plus 365days () Year 4 Plus180 days () Year 4 Plus 365days*		
Total No. of Coral Relocated: **Average size of coral relocated (***Time Zero only***):**	**Presence of Bleaching on Relocated Corals:** *No of Coral Colonies Bleaches: () Total % Bleached: ( )* **List of Species Bleached:**	
Presence and Type of Coral Disease:	**No. of Coral Colonies affected by Coral Disease:**	
General Condition of Surrounding Reef		
% Overall Live Coral Cover: **%Hard Corals: %Soft Corals:**	**% Species Composition:**	

<table>
<tr><td>Fish: Numbers ()

Species Observed:</td><td>% Algal Cover:

Overall weather Conditions:</td></tr>
<tr><td colspan="2">Water Quality Data:
Temperature: Total suspended solids: Nutrients {Nitrates and Phosphates}: Salinity:
Temperature: pH: Dissolved Oxygen: BOD: Feacal coliform: PAR:
Chlorophyll A:</td></tr>
<tr><td colspan="2">Comments, Observations, Ecological Trends:</td></tr>
</table>

11.1.3 Seagrass Management Plan

The Seagrass Management Plan will include a combination of seagrass survey/monitoring exercises and water quality monitoring before, during and after construction. The activities will be conducted by qualified and trained marine scientists and SCUBA divers.

<u>Seagrass Surveys</u>

Ten or more $0.25m^2$ quadrats, divided into 10cm x 10cm grids, will be placed randomly within the Seagrass Beds to be assessed. Within each quadrat, seagrass percentage cover, shoot density and leaf blade length of 10 random blades will be recorded. Other observations to be made included: epiphytic cover, bioturbation, overall health and appearance, and other organisms located within the seagrass beds. The location of each quadrat assessed will be recorded using a GPS.

<u>Water Quality Monitoring</u>

Temperature, pH, salinity, conductivity, dissolved oxygen, light irradiance, turbidity and total dissolved solids will be measured *in situ* using a Hydrolab DataSonde DS-5 multiprobe at the seagrass monitoring locations, plus other locations in and around the project area. A total of no less than four (4) water quality monitoring locations will be chosen. Water quality readings will also be taken on the inside and outside of silt screens deployed (during construction). The results of the data collected will be compared with National Environment and Planning Agency (NEPA) marine water quality standards.

<u>Phasing and Monitoring Frequency</u>

The Seagrass Monitoring Programme will be implemented during three (3) phases:

- Pre-construction (to serve as a baseline)
- During construction period

- Post-construction (5 years assuming relocation)

The proposed frequency of monitoring is outlined below based on the various phases.

Pre-Construction

- One (1) seagrass survey
- One (1) water quality sampling run

During Construction

- Quarterly (every 3 months) seagrass surveys until the end of construction
- Weekly water quality monitoring, in particular turbidity monitoring.

Post-Construction

- Quarterly relocated seagrass monitoring for the first 2 years, then biannual thereafter. Water quality monitoring is also to be conducted alongside the relocated seagrass monitoring, at each relocation site, using the same frequency.

Seagrass Removal and Replanting Works (if any)

Any seagrass removal and replanting works to be conducted as a mitigation measure will be done in accordance with the NEPA Seagrass Relocation and Monitoring protocols (Table 11-5 and Table 11-6).

Table 11-5 NEPA-appointed Seagrass planting Summary Form – Weekly log of planting activities

<table>
<tr><td></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td rowspan="2">Persons Conducting Planting:

Authorized by:</td><td colspan="2">GPS Location of Planting Site (State format):</td><td colspan="2">Date of Planting:</td></tr>
<tr><td colspan="2">Site no:</td><td colspan="2">Week No:</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="2">Average Seagrass Harvested per day (m²):</td><td colspan="3">No. of Grids Harvested per week:</td></tr>
<tr><td colspan="2">Total Seagrass Harvester Per week(m²):</td><td colspan="3">No. of Grid Planted Per week:</td></tr>
<tr><td colspan="2">Total Seagrass Harvester Per week by species (m²):
Thalassia sp: Syringodium sp:</td><td colspan="2">Name of Harvested Grid</td><td>Name of Equivalent Planting Grid</td></tr>
</table>

Halodule sp:		
Total Seagrass Planted to Date (*This should include all seagrass planted up to the end of the week stated above***):**	**Overall weather conditions:**	
Comments and Observation:		

Table 11-6 NEPA-appointed Seagrass Monitoring Summary Form (post relocation monitoring)

Persons Conducting Monitoring: **Authorized by:**	**GPS Location of Planting Site** *(state format)***:**	**Date of Monitoring:**
	Site no: **Depth:**	**Survival Trend Graph:**
**Monitoring Period: Monitoring Period: (***) Time Zero () Time Zero Plus 60 days () Time Zero Plus 180 days () Time Zero Plus 365 days* *() Year 1 Plus 180 days () Year 1 Plus 365 days () Year 2 Plus 180days () Year 2 Plus 365days* *() Year 3 Plus 180 days () Year 3 Plus 365days () Year 4 Plus180 days () Year 4 Plus 365days*		
Average Leaf Length (cm):	**Percentage Cover Surviving:**	**Total Area replanted (m^2):**
Bioturbation Presence/Absence/Type of Animals noted:		

Water Quality Data: *Temperature:* *Total suspended solids:* *Nutrients {Nitrates and Phosphates}:* *Salinity:* *Temperature:* *pH:* *Dissolved Oxygen:* *BOD:* *Feacal coliform:* *PAR:*
Incidence and Extent of Erosion: N/A
Date and Extent of Remedial Planting *if any (details should be outlined on the remediation monitoring form):* N/A
Comments, Observations, Ecological Trends:

11.2 DRAFT ENVIRONMENTAL MONITORING PLAN

11.2.1 Site Preparation and Construction Phase

- Undertake weekly water quality monitoring (for the first 3 months, then fortnightly thereafter) for temperature, salinity, pH, Dissolved Oxygen, light irradiance and turbidity in and around the project area, or at a frequency agreed to with NEPA to ensure that the construction works are not negatively impacting on water quality.
  Any organization with the capability to conduct monitoring of the listed parameters should be used to perform this exercise. It is recommended that a report should be given to NEPA at the end of each monitoring exercise. This is estimated to cost approximately **J$140,000** per weekly turbidity monitoring exercise.
- Daily inspections to ensure that construction activities are not being conducted outside of regular working hours (e.g. 7 am – 7 pm). In addition to environmental noise monitoring, a noise survey should be undertaken to determine workers exposure and construction equipment noise emission. Noise monitoring to be conducted monthly at the site and settlements near to site.
  The project engineer / site supervisor should monitor the construction work hours. NEPA should conduct spot checks to ensure that the hours are being followed. The noise survey is estimated to cost approximately **J$300,000** per monitoring exercise.
- Daily monitoring to ensure that fugitive dust from raw materials are not being entrained in the wind and creating a dust nuisance.
  The project engineer / site supervisor should monitor the construction work hours. NEPA should conduct spot checks to ensure that this stipulation is being followed.
- Conduct daily inspections to ensure that flagmen where necessary are in place and that adequate signs are posted along the roadways where heavy equipment interact with existing roads. This is to ensure that traffic have adequate warnings and direction.
- Undertake daily assessment of the quantity of solid waste generated and keep records of its ultimate disposal. Additionally, solid waste generation and disposal of the campsite should also be monitored.
- Weekly assessment to determine that there are adequate numbers of portable toilets and that they are in proper working order. This will ensure that sewage disposal will be adequately treated.
- Daily monitoring of vehicle refuelling, and repair should be undertaken to ensure that these exercises are carried out on hardstands. This is to reduce the potential of water/soil/sand contamination from spills. Spot checks should be conducted by NEPA.
- Traffic and maritime operations should be monitored to ensure approved management plans at critical areas are being followed. NEPA and NWA and other relevant authorities should perform spot checks to ensure compliance. Monitoring should be conducted daily to ensure major disruption is avoided. Reports should be made to NWA on a fortnightly basis.

- Undertake daily inspections to ensure that workers are wearing adequate personal protective equipment (PPE), such as hard hats, hard boots, air protection, safety glasses, reflective vests and fall protection is necessary. Ensure that safety signage is in place.
- Health, safety and emergency response plans should be prepared prior to site preparation and construction phases.
- Where possible, construction crews should be sourced from within the study area. This will ensure that the local community will benefit from the investment.
- Coral and seagrass in the vicinity of the monitoring sites should be monitored quarterly or at a frequency agreed to with NEPA. This will include:

  1) Photo Inventory and/or Roving Surveys:

  Corals of particular interest (endangered species, diseased or bleached colonies for example), Fish species and counts. This is estimated to cost approximately **J$ 425,000** per monitoring exercise.

  2) To monitor the potential sediment impact from construction activities on the marine environment, one sediment trap should be deployed in the vicinity of construction activity and in nearby sensitive reef areas. The settlers should be retrieved on a monthly basis, its contents analysed and redeployed to determine the rate of sedimentation (mg/cm^2/day) and dispersal patterns over the area. This is estimated to cost approximately **J$ 310,000** per monitoring exercise.

- Mangrove swamp water quality will also be monitored to ensure there is no drainage of oil, lubricants and excess sediments into the mangrove swamp.

11.2.2 Operational Phase

- Water quality monitoring should be done at least fortnightly after construction. If three to six results demonstrate that the site or parts of the site have stabilised, the sampling frequency and sampling locations may be reviewed and reduced or discontinued as per and approved monitoring plan. This is estimated to cost approximately **J$ 140,000** per monitoring exercise.
- Monitor the potential sediment impact on the marine environment, sediment traps should be deployed in the vicinity of the villas and in nearby sensitive reef areas. The settlers should be retrieved on a monthly basis, its contents analysed and redeployed to determine the rate of sedimentation (mg/cm^2/day) and dispersal patterns over the area. This is estimated to cost approximately **J$ 310,000** per monitoring exercise.

11.2.3 Reporting Requirements

11.2.3.1 Water Quality

A report shall be prepared by the Contracted party. It shall include the following data:

i. Dates, times and places of test.
ii. Weather condition.
iii. A defined map of each location with distance clearly outlined in metric.

iv. Test Method used.
v. Parameters measured
vi. Results
vii. Conclusions

The report will be submitted to the Client or his designate within two weeks of the monitoring being completed.

The Client shall distribute the report within four (4) weeks of testing being completed to NEPA.

In the event that the water quality does not meet the required criteria, investigations shall be carried out and corrective actions were necessary taken and a re-test shall be scheduled at the earliest possible time and a new report submitted.

If three (3) to six (6) results demonstrate that the site or parts of the site have stabilised, the sampling frequency and sampling locations may be reviewed and reduced or discontinued as per approved monitoring plan.

Reports will be maintained on file for a minimum of three years.

11.2.3.2 Coral and Fish

A report shall be prepared by the Contracted party. It shall include the following data:

1) Percentage Coral Cover
   a. Live coral
   b. Recently killed coral
   c. Dead coral
   d. Diseased or bleached coral
2) Percentage Algae Cover
   Where possible Algae will be identified and categorised (fleshy, calcareous and cyanobacteria.
3) General Substrate Composition
   The substrate type will also be identified (sand, pavement rock etc.)
4) *Diadema sp.* Counts
5) Sediment Dispersal
6) Fish counts, species and size classes
7) Presence of fish nets, pots, spearfishers, invasive and rare species.
8) Dates, times and places of test.
9) Weather condition.
10) A defined map of each survey location with distance clearly outlined in metric.
11) Other Data

Any rare, endangered, commercially important (lobster and conch) and invasive organisms (lionfish) observed will also be noted and photographed, as well as the presence/absence of seagrasses. Any obvious sedimentation, anchor damage, marine debris and other direct impacts will also be recorded.

The report will be submitted to the Client or his designate within two weeks of the monitoring being completed.

The Client shall distribute the report within four (4) weeks of testing being completed to NEPA.

Reports will be maintained on file for a minimum of three years.

11.2.3.3 Seagrass

A report shall be prepared by the Contracted party. It shall include the following data:

1. Percentage cover of various seagrass species
2. Shoot density
3. Leaf blade length
4. Presence of fish nets, pots, invasive and rare species.
5. Dates, times and places of test.
6. Weather condition.
7. A defined map of each survey location with distance clearly outlined in metric.
8. Other Data

Any rare, endangered, commercially important (lobster and conch) and invasive organisms (lionfish) observed will also be noted and photographed, as well as the presence/absence of seagrasses. Any obvious sedimentation, anchor damage, marine debris and other direct impacts will also be recorded.

The report will be submitted to the Client or his designate within two weeks of the monitoring being completed.

The Client shall distribute the report within four (4) weeks of testing being completed to NEPA.

Reports will be maintained on file for a minimum of three years.

12.0 CONCLUSION AND RECOMMENDATIONS

This proposed development is slated to increase the room offerings of the island, thereby creating jobs and economic benefits, growing the tourist clientele and in the process enhance and diversify the Jamaican tourism product.

On the contrary, the degradation, loss and adverse effects of natural habitats as well as impacts on the noise climate, air quality and solid waste facilities, are some of the potential negative impacts of the project. These concerns are highlighted through the stakeholder involvement and public interviews conducted for the purposes of this EIA.

The implementation of the recommended mitigation measures detailed in this EIA, as well as the various environmental management and monitoring programmes, will assist in reducing these negative impacts.

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14.0 APPENDICES

Appendix 1 – Terms of Reference

AMENDED

TERMS OF REFERENCE
For An
ENVIRONMENTAL IMPACT ASSESSMENT

For

Hotel Development

At

Green Island, Hanover

By

Princess Hotels and Resorts

Date: 14 January 2020
Submitted By: C.L. Environmental Company Limited
Prepared by: Dr. Carlton Campbell

Table of Contents

Project Description

Princess Hotels and Resorts has designed an Ecological Resort with low occupation of land, less than the allowed one, where buildings create natural spaces, in most cases perpendicular to the sea, having a low impact from the coast, as shown in the elevations included in the Graphic Documentation of this Master Plan.

The Resort has four hotels of category "5 STARS GRAND LUXURY" and fourteen over water rooms to be built in two phases (Figure 1). In each phase, there are two hotels that share the service area, making the occupation of the land and its environmental impact much lower, because operationally they will work as a single hotel. This means that for each two hotels there will only have one centralized kitchen, one industrial area, one warehouse area, one personnel area etc. In each phase, one of the two hotels will be "Adults Only", with the objective of differentiating and diversifying the product. It is also important to emphasize that each of the two hotels in the two phases will have a Platinum Area, which is nothing more than an exclusive hotel within the hotel itself.

The Resort will comprise of 4 different hotels, with a total of 2,037 rooms according to the following table:

Phase I:	1.012 H. Rooms
HOTEL I.	**414 H. Rooms**
Hotel Adults Only	256 H. Rooms
Hotel Platinum Adults	158 H. Rooms
HOTEL II.	**598 H. Rooms**
Hotel	448 H. Rooms
Hotel Platinum	150 H. Rooms

These four hotels have a common service area.

Phase II:	1.025 H. Rooms
HOTEL III.	**590 H. Rooms**
Hotel	440 H. Rooms
Hotel Platinum	150 H. Rooms
HOTEL IV.	**435 H. Rooms**
Hotel Adults Only	332 H. Rooms
Hotel Platinum Adults	103 H. Rooms

All existing roads will be used as access roads thereby maximizing the use of these existing paths to maintain natural spaces. The Main Access to the Resort will be made by the existing access to the land from the Main Road and will be developed along the current path, adapting it to the logistical and traffic safety needs necessary for this use. There will be a casino as an independent building inside the Resort, separated from the hotels, with its own access and vehicle parking area. The hotels will have all rooms with sea views. Electricity supply will be obtained from the Jamaica Public Service, portable water from the National Water Commission and a wastewater plant will be constructed to treat the wastewater from the resort.

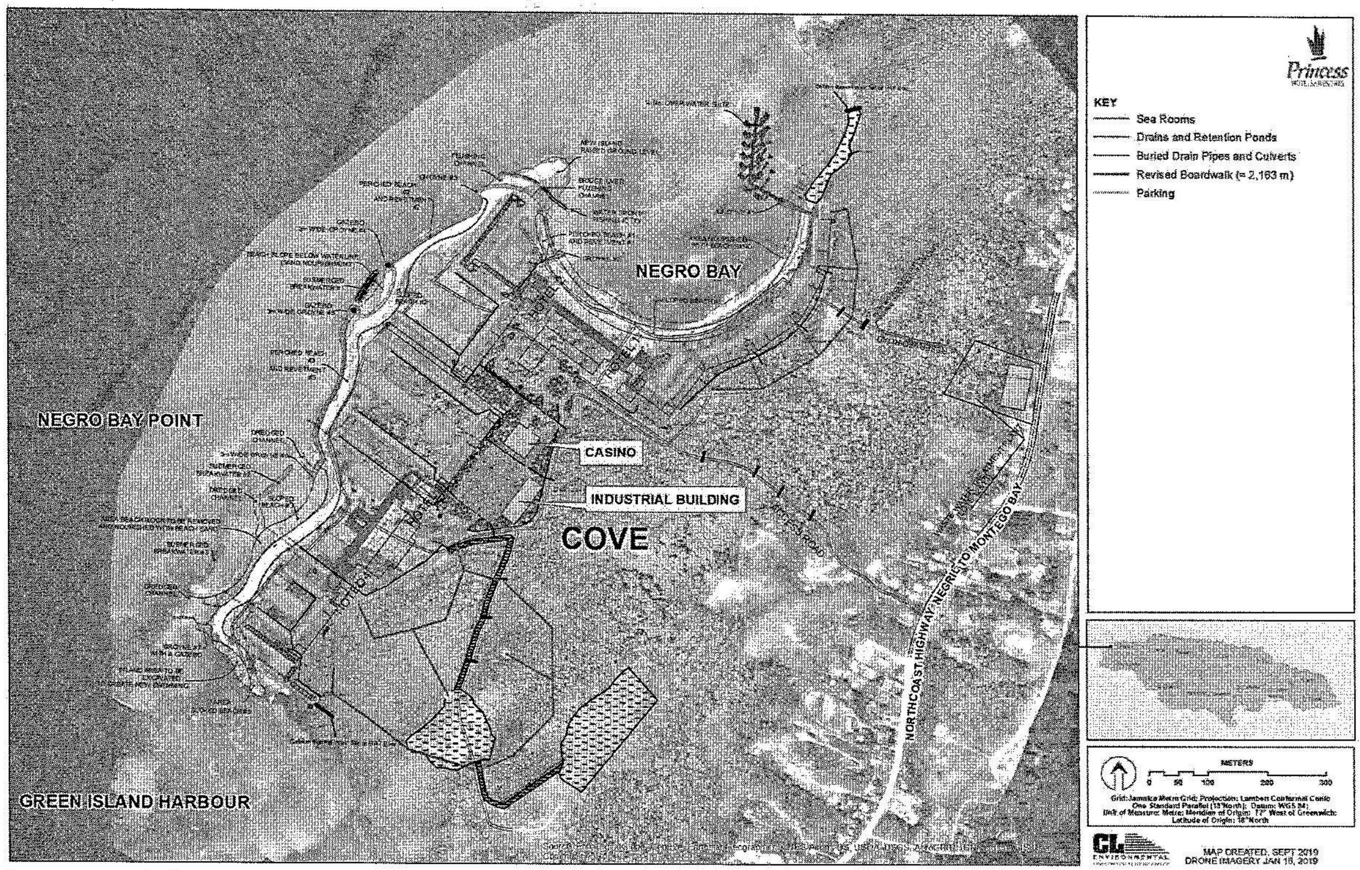

Figure 1 Master Plan for the proposed Princess Hotels and Resorts hotels, Industry Cove, Green Island, Hanover

NATIONAL ENVIRONMENT & PLANNING AGENCY
Terms of Reference for an Environmental Impact Assessment
Proposed Princess Hotels, Industry Cove, Green Island, Hanover by Princess Hotels and Resorts

Foreword

The purpose of this document is to establish the Terms of Reference (TOR) for the Environmental Impact Assessment (EIA) for Princess Hotels and Resorts Hotel Development, Green Island, Hanover. An EIA seeks to identify the impacts the proposed project is likely to have on the area in which the physical development will be carried out as well as the impact of the environment on the proposed development. It also outlines mitigation measures necessary to reduce the negative impacts of the project.

The EIA will be prepared using a participatory approach involving key stakeholders. The EIA report must be produced in accordance with the agreed TOR issued by the National Environment and Planning Agency (NEPA) to Princess Hotels and Resorts.

Where the need arises to modify the TOR, the required amendments/modifications are to be made and submitted to the Agency. Approval for the TOR must be obtained from the Agency, in writing, prior to the commencement of the EIA study.

The National Environment and Planning Agency and the Natural Resources Conservation Authority (NRCA) reserves the right to reproduce, transfer and disclose any and all contents contained in the submitted environmental impact assessment report without the written consent of the proponent, consultants and/or its agents.

The Terms of Reference to conduct the Environmental Impact Assessment (EIA) are as follows:

1.0 EXECUTIVE SUMMARY

Provide a brief statement on the content of the EIA report. The executive summary should provide a comprehensive overview and objectives for the project proposal, natural resources, justification for the project, etc. In addition, it should include relevant background information and provide a summary of the main findings, including but not limited to main impacts and mitigation measures, analyses and conclusions in the report.

2.0 INTRODUCTION

The introduction should provide a background and seek to explain the need for and the context of the project and the EIA. It should also provide the delineation and justification of the boundary of the study area, general methodology, assumptions and constraints of the study. Additionally, a profile of the project proponent, implementing organization, project consultants, etc. should also be provided. The study area shall include at least the area within a 2km radius of the boundaries of the proposed project area.

3.0 LEGISLATION AND REGULATORY CONSIDERATION

This section should provide details of the pertinent regulations, standards, policies and legislations governing environmental quality, safety and health, cultural significant finds, protection of sensitive areas, protection of endangered species, tourism enterprises, siting and land use control at the local and national levels. The examination of the legislation should include at a minimum the Natural Resources Conservation Authority Act 1991, Natural Resources Conservation Regulations 1996, amended 2015, Natural Resources Conservation (Wastewater and Sludge) Regulations, 2013, Beach Control Act, Wild Life Protection Act, Jamaica National Heritage Trust Act, Wild Life Protection Act, the Fishing Industry Act, National Solid Waste Management Authority Act, the Town and Country Planning Act, Building Act and Codes and Standards promulgated there under, Planning Guidelines – Overwater Structures, Development Orders and Plans and all appropriate international convention/protocol/treaty where applicable. Describe traditional land use and advise of any prescriptive rights including public access rights.

4.0 METHODOLOGY AND APPROACH

Clearly outline the methodologies and approaches in conducting the study including collecting and analysing data, stakeholder consultation, dates on which surveys were conducted etc.

5.0 PROJECT DESCRIPTION

The report should provide a comprehensive description of all proposed terrestrial and marine project component, including information necessary to identify and assess the potential environmental impacts of the project. This should include but not be limited to:

- An overall master plan of the site including current, proposed and future use of the lands showing the various components and design elements of the proposed development
- Location Map and total site area
- Objectives and information on, rationale for the project;
- History and Project Background, the nature, location/existing setting, timing, duration, frequency, general layout, as well as the impact on the carbon footprint of the energy sector are to be discussed;
- Existing site and its characteristics (landward & seaward)
- Description of the surrounding areas
- Site maps illustrating areas to be impacted and areas to be preserved in their existing state
- Hotel construction methods, works, duration and maintenance schedule, which must include methodology for the proposed cutting/trenching, beach nourishment, coastal protection works and overwater suites.
- Detailed description of the project, project objectives and phases (where applicable), including all applicable timelines for the various aspects of the project (from pre to post development). The description should also provide details of the design concept, design components, material(s) to be used, total number, size, and types of guest rooms/suites, boardwalk or means of access to the overwater rooms; design height of structures above sea level; and supporting services such as administrative, "back-of-house" facilities and amenities to serve the proposed development such as pools, restaurants, chapel etc. This should be supported using maps, diagrams and other visual aids where appropriate.
- Detailed description of all activities and features which will introduce risks or generate an impact (positive or negative) on the environment including but not limited to mangrove removal, seagrass and/or coral relocation and shading; collection, beach works, transfer, and disposal of waste (solid waste and sewage); provision of potable water and electricity; and dredging/excavation.
- Details of the methods, equipment and machinery to be employed to undertake each aspect of the project including coral/seagrass relocation, dredging/excavation, transportation of material, disposal of spoils (if applicable), storage of material, installation of pylons,

construction of units, installation of required infrastructure and secondary activities such as refuelling of vessels, proposed location(s) for equipment storage (staging area) and establishment of a site office.

- The study area should be clearly delineated and referenced. Considering the types of resources located in the area and the magnitude of the associated impacts, the study area should be large enough to include all valued resources that might be significantly affected by the project.
- Detailed drainage report which should be designed for a 1 in 100-year event
- Details regarding access points and accessibility to the proposed work site(s)
- Estimated duration of the project for construction
- Details of any required decommissioning of the works and/or facilities.

6.0 DESCRIPTION OF ENVIRONMENT

This section should include a detailed description of the proposed sites (marine and terrestrial) and surrounding environment. Baseline data should be generated in order to give an overall evaluation of the existing environmental conditions. The study area should be large enough to include all valued resources that might be significantly affected by the project. This information will form the basis upon which impacts of the project will be assessed. The following aspects should be described in this section, broken down into the following:

- Physical Environment
- Biological Environment
- Socio-economic and Cultural/Heritage

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6.1 Physical Environment:

- Topography, soils, climate/meteorology, drainage (including gullies), geology (including but not limited to rock type and formation, susceptibility to erosion, seismicity and faults), geomorphology of the site and impacts on current landscape, aesthetic appeal and hydrology should be examined. Special emphasis should be placed on storm water runoff and drainage patterns within and outside of the mangrove swamp. A Geotechnical study should also be conducted within the proposed project area (on land and in the overwater structure footprint).
- Hydrodynamics, including but not limited to bathymetry, waves (hurricane, operational and swell), currents, tides and baseline sediment transport and circulation patterns.
- Water Quality of the marine environment and mangrove swamp. Baseline water quality should include study areas and associated environs and control sites. These should be accurately mapped, and a spatial comparison of the data should be done in order to determine any possible source(s) of pollutants. Water quality should include but not be limited to the following parameters:
    - Physical parameters: Temperature, salinity, conductivity, pH, dissolved oxygen, turbidity and Total Dissolved Solids.
    - Chemical Parameters: Total Suspended Solids, Nitrate, Phosphate, Total Petroleum Hydrocarbons.
    - Biological Parameters: Biochemical Oxygen Demand, Faecal Coliform, Enterococcus.

Results from the water quality sampling should be compared to NRCA water quality standards.

- Analysis of Marine Sediments to should include but not be limited to the following parameters:
    - Arsenic
    - Cadmium
    - Mercury
    - Lead
    - Total Petroleum Hydrocarbons
- Analysis of Sediment Loading in project area
- Noise levels of undeveloped site and the ambient noise in the area of influence.
- Particulate Matter (PM10 and PM2.5) of the undeveloped site and in the area of influence.
- Sources of existing pollution (coastal, surface and groundwater) and extent of contamination.

6.2 Biological Environment:

Detailed description of terrestrial and marine habitats, existing vegetation type, detailed floral and faunal surveys inclusive of a species list; commentary on the biodiversity, ecological health and function in the project area, threats and conservation and significance. This should include:

- A qualitative and quantitative assessment of ecologically sensitive terrestrial and marine habitats in and around the proposed project sites and the areas of impact.
- Benthic surveys should be conducted with emphasis placed on the working footprint (seafloor) which will be impacted by the proposed project structures/features such as coastal protection works, overwater structures, beach nourishment and dredging/excavation.
- A species list of terrestrial flora and fauna (including herpetofauna, avifauna – West Indian Whistling Duck, invertebrates and bats) should be generated with special emphasis on those species considered rare, threatened, endangered, endemic, protected, invasive and economically or nationally important. Identification and description of the different ecosystem types and structure including species dominance, possible biological loss or habitat fragmentation ought to be considered.
- Habitat Map of area
- Any crocodile, sea turtle or bird nests observed in or around the project area should be recorded and mapped. This should be supported by information including but not limited to the following; existing sea turtle and bird nesting sites and seasons and habitat usage by migratory species

6.3 Mangrove Community

- A detailed assessment of the mangrove ecosystem should be conducted to include:
    - Tree species and numbers within sample area
    - Tree heights(m) for up to 10 of each species present
    - Diameter at breast height (DBH)in cm, for up to 10 of each species present
    - Density of mangrove seedlings within 1 m^2.
    - Visible fauna
    - Water level on the forest floor
    - Water quality in mangrove swamp (salinity, nitrate, phosphate, pH)
    - Possible impact of wetland modification activities on surrounding areas
    - Determination of amount of mangrove to be impacted
    - Overall health and appearance and signs of human disturbance. The location of each transect will be recorded using a GPS.

- Provision of options suitable to compensate for the unavoidable loss of mangrove trees, including a mangrove monitoring and rehabilitation plan.

Special emphasis must be placed on the hydrology within the mangrove swamp as well as investigating the existing mangrove mortality within the swamp and possible steps to rehabilitate.

6.4 Natural Hazards

Natural Hazards and Disaster Risk Reduction for Climate Change, in relation to:

- Earthquakes
- Hurricane
- Storm surges (coastal flooding)
- Flooding
- Beach Stability

The natural hazard risk assessment should take in account climate change projections for return periods of 25, 50 and 100 years.

6.5 Cultural/Heritage

An assessment of artefacts, archaeological, and paleontological features of the site. The historical importance of the area should also be examined including identification of culturally significant features e.g. archaeological finds. Where there is a need this should be conducted in collaboration with the Jamaica National Heritage Trust.

6.6 Traffic Impact Assessment

The objectives are to investigate the potential impact of the traffic during construction and during operations on the existing and future main road traffic. Two accesses will be required, with one being the main entrance that will be either signalized or not and the other unsignalized and used very infrequently.

It will involve:

- Meeting with the Hanover Municipal Corporation and National Works Agency to discuss the project parameters and assumptions that will be made to refine the scope of works required for approval
- Background Data Collection
    - Existing traffic count data on main road and associated intersection
    - Field/road conditions parameters will be collected for all the relevant roads and intersections
    - Other developments currently planned within the area

The data collected will be used to describe the existing conditions at all the selected locations. Comparisons will also be drawn to show what the existing conditions are as opposed to what the standards recommend. Analysis will be conducted to determine the existing Level of Service (LOS) at each intersection as well as on the roads.

The potential impact of hotel construction and operations on LOS will be determined and recommended mitigation measures provided.

6.7 Socioeconomic and Cultural/Heritage:

This section should provide details on: Demography, regional setting, current and potential land-use patterns; description of existing infrastructure such as transportation, electricity, water and telecommunications, and public health and safety; should be explored and other material assets of the area should also be examined. This will be done within 5 km of the proposed site.

A socio-economic survey to determine public perceptions of the project (both negative and positive) should also be completed and this should include but not be limited to potential impacts on social, physical, biological and historical/cultural values. This assessment may vary with community structure and may take multiple forms such as public meetings or questionnaires. The methodology for conducting the survey should be included as part of the EIA report.

7.0 PUBLIC PARTICIPATION

Describe the public participation methods, timing, type of information provided and collected from public and stakeholder target groups meetings. The instrument used to collect the information must be included in the appendix. It may be useful and necessary to hold stakeholder meetings to inform the public of the proposed development and the possible impacts. This will also gauge the feeling/response of the public toward the development.

The issues identified during the public participation process should be summarized and public input that has been incorporated or addressed in the EIA should be outlined.
Public Meetings should be held in accordance with the Guidelines for Conducting Public Presentation at a time and location signed off by the National Environment and Planning Agency (NEPA). A public meeting will be held to present the findings of the EIA once the EIA is completed and submitted for consideration. All relevant documents are required to be made available to the public. In addition, any material change to the design of the project will require a further public meeting to be undertaken by the developer and all changes made to the document. should be clearly outlined to the public.

8.0 NATURAL RESOURCE VALUATION

An Ecosystem Service and Natural Resource Valuation Assessment (ESV and NRV) will be conducted of the proposed hotel development. There will be an identification of in situ ecosystem services and where feasible monetary values assigned to them. The study will include but not limited to the following:

- Economic Valuation of Ecosystem Services using the benefit transfer method
- Economic Value of Carbon
- Damage Cost Avoided Approaches
- Market Based Approaches

The following tasks will be conducted

1. Conduct policy analysis and review of supporting studies for the site and study area (proposed project)
2. Conduct a comprehensive review of the relevant economic valuation literature

3. Based on literature review conduct benefit or value transfer analysis and where possible provide economic value for the key ecosystems (mangroves, seagrasses, coral reefs) associated with the site
4. Provide a discussion of the likely loss in economic value based on negative impacts of development (irreversible habitat loss) associated with proposed activities and suggestions for possible mitigation of the economic costs of the development action.

9.0 IDENTIFICATION AND ASSESSMENT OF POTENTIAL IMPACTS

A detailed analysis of the project components should be done in order to: identify the major potential environmental and public health impacts of the project; distinguish between levels of impact, significance of impact (a ranking from major to minor/significant to insignificant should be developed), positive and negative impacts, duration of impacts (long term or short term or immediate), direct and indirect and impacts, reversible or irreversible, long term and immediate impacts and identify avoidable impacts.

Cumulative impacts should also be evaluated considering previous developments and any proposed development immediately adjacent to the subject development within the area. The identified impacts should be profiled to assess the magnitude of the impacts. The major concerns surrounding environmental and public health issues should be noted and their relative importance to the design of the project and the intended activities indicated.

The extent and quality of the available data should be characterized, explaining significant information deficiencies and any uncertainties associated with the predictions of impacts. A major environmental issue is determined after examining the impact (positive and negative) on the environment and having the negative impact significantly outweigh the positive. It is also determined by the number and magnitude of mitigation strategies which need to be employed to reduce the risk(s) introduced to the environment. Project activities and impacts should then be ranked as major, moderate and minor and presented in separate matrices for all the phases of the project (i.e. preconstruction, construction, operational and decommissioning/closure). The potential impacts may be subdivided into Physical Impacts, Biological Impacts and Socio-economic/Cultural Impacts. All impacts should be listed, ranked and assessed.

The impacts to be assessed should include but not be limited to the following:

9.1 Physical Impacts:

- Construction activities such as site clearance, earthworks and spoil disposal.
- coastal modification and shoreline modification including but not limited sandy and rocky shore ecosystem.
- Removal of seagrass and corals, relocation of seagrass and corals, shading
- Sediment plume dispersal,
- Reef modification
- Modification of waves and current patterns
- Water quality (during construction and operation)
- Geotechnical and engineering requirements
- Spoil Disposal
- Impacts of potential spills (such as oil and chemical spills)
- Drainage
- Traffic

- Solid Waste
- Noise impacts
- Operation and maintenance – provision of and demand requirements for potable water and electricity, waste disposal, sewage treatment and disposal, communication and other utility requirements
- Impacts on aesthetics, landscape and seascape

9.2 Biological Impacts:

This should include an assessment of the direct and indirect impacts of the project on the ecology of ecologically sensitive marine ecosystems with emphasis being placed on rare, endemic, threatened, protected, endangered, invasive, and economically important species.

An assessment of the direct and indirect impacts of the project on the mangrove community should also be conducted. This should include but not be limited to:

- Provision of options suitable to compensate for the unavoidable loss of mangrove trees, including a mangrove monitoring and rehabilitation plan.
- Determination of amount of mangrove to be impacted
- Rehabilitation Sites

Project impact (land clearance, noise, dust) on other floral and faunal species (birds, herpetofauna, bats etc.) should be explored, with emphasis on impacts on the West Indian Whistling Duck.

9.3 Natural Hazards

Potential impact of natural hazards including tropical storms, hurricanes and tsunamis

9.4 Socioeconomic/Cultural/Heritage Impacts:

Effects on the socio-economic status such as changes to public access and recreational use; impacts on existing and potential economic activities; contribution of the development to the national economy and development of surrounding communities should be examined. Socio-economic and cultural impacts to include land use/resource effects, health and safety of the potential workers as well as the residents of the surrounding environs should be described. Public perception as it relates to loss of property value, loss of aesthetic enjoyment among other things should be explored, as well as Loss of and damage to artefacts, archaeological and paleontological features.

10.0 MITIGATION

The mitigation measures should endeavour to avoid, reduce and remedy the potential negative effects while at the same time enhancing the positive impacts projected. Mitigation and abatement measures should be developed for each potential negative impact identified. Full details of the methods proposed to be employed in the implementation of these measures should be provided, including details on the scheduling/timelines, source of materials, location and responsible parties, where appropriate. Maps and diagrams should also be used to illustrate areas where mitigation measures are proposed to be implemented.

11.0 IDENTIFICATION AND ANALYSIS OF ALTERNATIVES

Alternatives to the proposed development/project including the no-action alternative should be examined. These should be assessed according to the physical, biological and socio-economic parameters of the site. This examination of alternatives should incorporate the use of the history of the overall area in which the site is located and previous uses of the site itself. Alternatives should also address specific aspects of the project such as methods proposed in the execution of the project (works) that have been identified as being causes of major impacts. A rationale for the selection of any project alternative should be provided.

12.0 ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

12.1 Environmental Management Plan

An Environmental Management Plan should be developed which will detail the requirements for the construction and operational phases of the project. This should include, but not be limited to methodology, training for construction and operation staff, recommendations to ensure that the implementation of mitigation measures and long-term minimization of negative impacts. Special emphasis should be placed on the preparation of an outline Coral Management Plan, Seagrass Management and Wetland Management Plan.

12.2 Environmental Monitoring Plan

An outline Environmental Monitoring Plan should be included in the EIA. At the minimum the outline monitoring plan should include:

- Introduction outlining the need for a monitoring programme
- The locations selected for monitoring
- The mitigation measures to be implemented and the parameters and activities which will be monitored for each activity
- The proposed methodology to be employed for the monitoring of the various parameter.
- The frequency of the monitoring
- The proposed format that the monitoring reports should take
- The frequency of the submission of the monitoring reports
- The responsible parties for the monitoring

13.0 CONCLUSION AND RECOMMENDATIONS

14.0 LIST OF REFERENCES

15.0 APPENDICES

The appendices should include but not be limited to the following documents:

- Reference documents
- Photographs/ maps

- Data Tables
- Glossary of Technical Terms used
- Terms of Reference
- Composition of the consulting team, team that undertook the study/assessment, including name, qualification and roles of team members
- Notes of Public Consultation sessions
- Instruments used in community surveys

All findings must be presented in the EIA report and must reflect the headings in the body of the TORs, as well as, references. GIS references should be provided where applicable. Two hard copies and an electronic copy must be submitted to NEPA for review after which the Agency will indicate the number of hard copies along with an electronic copy of the report to be submitted. One copy of the document should be perfect bound.

The report should include appendices with items such as maps, site plans, proposed streetscapes (that will demonstrate the preservation of the windows to the sea concept from the roadway), the study team and their individual qualifications, photographs, and other relevant information. All the foregoing should be properly sourced and credited.

Appendix 2 – Study Team

- **CL Environmental Co. Ltd.:**
    - Carlton Campbell, Ph.D., CIEC (Project Coordinator, GIS, Noise and Socioeconomics)
    - Matthew Lee, M.Sc. (Water Quality, Noise, Air Quality, Benthic Sediments)
    - Rachel D'Silva, B.Sc. (Marine and Benthic Studies)
    - Karen McIntyre, M.Sc. (Socioeconomics)
    - Alec Silvera, B. Sc (Marine and Benthic Studies)
    - Glen Patrick (Field Technician)

- **Smith Warner International Limited**
    - Jamel Banton (Senior Coastal Engineer)
    - Miles Harris (Coastal Engineer)
    - Vishwanath Maraj (Civil/Hydraulic Engineer)
    - Renee McDonald-Lyn Shue (Environmental Specialist and Geologist)

    Areas of Study:
        - Drainage and Hydrology
        - Currents and Tides
        - Wave Climate
        - Hurricane Wave Climate, Storm Surge
        - Sediment Transport
        - Sedimentology
        - Shoreline Morphology
        - Bathymetry
        - Marine Benthic Mitigation

- **Associate Consultants:**
    - CEAC Solutions Company Limited (Traffic Impact Assessment)
    - Camilo Trench, M.Sc. (Mangrove and Coastal Vegetation)
    - Eric Garraway, Ph. D (Terrestrial Faunal Studies)
    - Damion Whyte, M.Sc. (Terrestrial Faunal Studies)
    - Marc Rammelaere, M. Phil (Geology, Geomorphology, Geotechnical Aspects and Soils)
    - Jannette Manning, M.Sc. (Public Perception Survey)
    - Andre Fiffe (Topographic Survey)
    - Jamaica National Heritage Trust (Archaeological Impact Assessment)

Appendix 3 – NEPA Guidelines for Public Participation

SECTION 2

PUBLIC CONSULTATIONS GUIDELINES
FOR
ENVIRONMENTAL IMPACT ASSESSMENTS

SECTION 2 - TABLE OF CONTENTS

CHAPTER 1: GENERAL GUIDELINES

1.0 Introduction

There are two levels of public consultation involved in the Environmental Impact Assessment (EIA) process. The first is direct involvement of the affected public or community in public consultations during the EIA study. These consultations allow the developer to provide information to the public about the project and to determine what issues the public wishes to see addressed. The extent and results of these consultations are included in the documented EIA report.

The second level of involvement takes place after the EIA report is prepared in the form of a public meeting and the submission and review of comments on the EIA report. This occurs after the applicant has provided the information needed for adequate review by the public.

1.1 Purpose

These guidelines are prepared in relation to the second level of consultation outlined above for the use of the applicant and the public.

CHAPTER 2: SPECIFIC GUIDELINES FOR PUBLIC MEETING FOR ENVIRONMENTAL IMPACT ASSESSMENTS (EIAS)

2.1 Requirements

Arrangements for the public consultation, in particular the public meeting, must be made in discussion with NEPA in respect of date, time, venue, chairperson, specially invited participants and length of time for the submission of comments.

A permanent record of the meeting is required hence, the applicant must submit to NEPA a copy of the verbatim report of the public meeting within seven (7) days of the date of the meeting.

2.2 Public Notification

The public must be notified at least three (3) weeks before the date of the public meeting. The applicant must seek to ensure that in addition to specific invitation letters, at least **three (3)** notices are placed in the most widely circulated newspapers advertising the event; one (1) notice per week. A copy of the notice shall be forwarded to NEPA for approval prior to publication in the newspapers. The NEPA will also post a copy of the Notice on its Website once it has been approved. To ensure that the Notice is distributed as widely as possible, at least two (2) other methods of notification such as community notice boards, flyers, town criers etc. shall be utilized. In addition, specific notice to relevant local NGOs and community groups should be made by the applicants. Evidence of the two (2) additional methods of notification and specific notices must be submitted to the NEPA.

The notices should indicate that:-

-the EIA has been submitted to NEPA;

- the purpose of the meeting;
- how to access the EIA report for review;
- the date, time and venue of the public presentation;
- contact information (NEPA/NRCA/TCPA and the APPLICANT).

The public meeting should be conducted no less than 3 weeks after the EIA has been accepted for posting and has been made available to the public and no less than 3 weeks after the first notice announcing public meeting has been published by the applicant. ***(A typical notice is in***

Appendix 1).

2. 3 Responsibility of Applicant

The applicant is responsible for distribution of copies of the EIA Report to make them available to the public at least three (3) weeks before the public meeting. Copies should be placed in the Local Parish Library and the Parish Council Office as well as the NEPA Documentation Centre, NEPA Regional Office nearest to the project site and other community locations as agreed upon. A summary of the project components and the findings of the EIA in non-technical language should also be prepared for distribution at the public meeting.

2.4 Conduct of the Meeting

With respect to the conduct of the meeting, the chairperson should be independently selected so as to ensure his/her neutrality. NEPA should be consulted regarding the selection of a chairperson. The role and responsibilities of the chairperson are outlined in ***Appendix 3***.

2.5 The Presentation

The technical presentation by the applicant should be simple, concise and comprehensive. The main findings of the EIA including adverse and beneficial impacts identified and analyzed should be presented. **(A typical agenda for a meeting is given in Appendix 2)**

Mitigation measures and costs associated with these measures should be presented. The meeting should inform the public on how they will get access to monitoring results during the construction and operational phases of the project, as it seeks to facilitate their participation in the monitoring and enforcement of the conditions under which approvals may being granted. Graphic and pictorial representations should support the technical presentation.

Presenters are advised to keep the technical presentation simple and within a time limit of 20-30 minutes depending on the complexity of the project and to allow a minimum of 30 minutes for questions. ***(A typical outline of a Project presentation is given in Appendix 4)***

2.6 Submission of Verbatim Report

The applicant will submit to NEPA a copy of the verbatim report of the public meeting within seven (7) days of the date of the meeting.

2.7 Submission of Public Comments

Please note that the public will be given a period of twenty-one (21) days after the public meeting to submit written comments to NEPA.

CHAPTER 3: CONDUCTING SUBSEQUENT PUBLIC CONSULTATIONS

The applicant is required to conduct other public consultations once the scope and size of the project has changed significantly; once deemed necessary by the Authority. The additional consultation may be required whether or not a permit has already been granted and issued for the development.

3.1 Requirements

Arrangements for the public meeting must be made in consultation with NEPA in respect of date, time, venue, chairperson and participants.

A permanent record of the meeting is required hence, the project proponent/consultant will submit to NEPA a copy of the verbatim report of the public meeting within seven (7) days of the date of the meeting.

3.2 Public Notification

The public must be notified at least one (**1) week** before the date of the public presentation. The developer/consultants must seek to ensure that in addition to specific invitation letters; at least **one (1) notice** is placed in one of the most widely circulated newspapers advertising the event. The notice shall also be forwarded to NEPA for posting on its website. To ensure that the notice is distributed as widely as possible, other methods of notification such as community notice board, flyers, town criers etc. shall be utilized as appropriate. In addition, specific notice to relevant local NGOs and community groups should be made by the developer/consultants.

The notice should indicate that:-

- the purpose of the meeting
- changes have been made to original proposal for which the EIA has been submitted to NEPA;
- how to access the EIA report for review;
- the date, time and venue of the public meeting;
- contact information.

The public meeting should be conducted no less than **one (1) week** after the document outlining the changes and any supporting technical information have been made available to the public and no less than **one (1) week** after the notice announcing public meeting has been

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published by the applicant. ***(A typical notice is in Appendix 5).***

3.3 Responsibility of Applicant

The applicant is responsible for distribution of the document outlining the changes and any supporting technical information to the public at least **one (1) week** before the public meeting. The document outlining the changes and any supporting technical information should be placed in the Local Parish Library and the Parish Council Office, NEPA Documentation Centre as well as at the NEPA Regional Office nearest to the site and any other community locations as agreed upon.

A summary of the project components, highlighting the changes in non-technical language should also be prepared for distribution at the public meeting.

3.4 Conduct of the Meeting

With respect to the conduct of the meeting, the chairperson should be independently selected so as to ensure his/her neutrality. NEPA should be consulted regarding the selection of a chairperson. The role and responsibilities of the chairperson are outlined in ***Appendix 3***.

3.5 The Presentation

The technical presentation by the applicant should be simple, concise and comprehensive. The changes to the proposal and any supporting technical information should be presented as well as any adverse and beneficial impacts identified and analyzed. **(A typical agenda for a meeting is given in Appendix 7)**

Mitigation measures and costs associated with these measures should be presented. The meeting should inform the public on the ways in which monitoring results may be accessed during the construction and operational phases of the project, bearing in mind that the public and non-governmental groups are expected to be involved in post-approval monitoring. Graphic and pictorial documentation may support the technical presentation.

Presenters are advised to keep the technical presentation simple and within a time limit of 20-30 minutes depending on the complexity of the project and to allow a minimum of 30 minutes for questions. ***(A typical outline of a Project presentation is given in Appendix 6)***

3.6 Submission of Verbatim Report

The applicant will submit to NEPA a copy of the verbatim report of the public meeting within **seven (7) days** of the date of the meeting.

3.7 Submission of Public Comments

Please note that the public will be given **ten (10) days** after the public meeting to submit written comments to NEPA.

APPENDICES

APPENDIX 1

NOTIFICATION OF PUBLIC MEETING

THERE WILL BE A PUBLIC CONSULTATION ON THE ENVIRONMENT IMPACT ASSESSMENT REPORT

OF:

VENUE:

DATE:

TIME:

THE PUBLIC IS INVITED TO PARTICIPATE IN THE CONSULTATION BY WAY OF ASKING QUESTIONS RELATING TO THE PROPOSED PROJECT.

A COPY OF THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT MAY BE CONSULTED AT THE

_____________________ PARISH LIBRARY
_____________________ PARISH COUNCIL OFFICE
NEPA'S Documentation Centre at 11 Caledonia Avenue, Kingston 5
_____________________ NEPA Website: www.nepa.gov.jm
For further information contact:

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APPENDIX 2

AGENDA

1. WELCOME AND INTRODUCTION

2. STATEMENT BY THE NATIONAL ENVIRONMENT & PLANNING AGENCY

3. PRESENTATION OF EIA FINDINGS AND MEASURES TO MINIMIZE IMPACTS

4. QUESTION AND ANSWER SESSION

5. CLOSING REMARKS

APPENDIX 3

ROLE AND RESPONSIBLITIES OF THE CHAIRPERSON

The chairperson has the main role of guiding the conduct of the meeting and seeing to it that the concerns of the public are adequately aired and addressed by the proponent/consultants.

The responsibilities of the chairperson include explaining the NEPA approval process, that is, the steps involved and the role of the NEPA at these public presentations. In other words, the chairperson should explain the context within which the meeting is taking place.

The chairperson should ensure that adequate time is allowed for questions and answers, and must understand clearly and communicate the purpose of the meeting to the audience. The chairperson is responsible for introducing the presenters.

The chairperson should contribute to but not monopolize the meeting.

APPENDIX 4

STRUCTURE OF PRESENTATION

1. DETAILED DESCRIPTION OF PROJECT PROPOSAL

2. DETAILS OF IMPACTS IDENTIFIED

3. DESCRIPTION OF PROPOSED MITIGATION MEASURES

4. RESPONSE TO ANY ISSUES RAISED PRIOR TO PUBLIC CONSULTATION (MEDIA, WRITTEN QUERY ETC.)

APPENDIX 5

NOTIFICATION OF PUBLIC MEETING - CONDUCTING SUBSEQUENT PUBLIC CONSULTATIONS

FURTHER TO THE ENVIRONMENTAL IMPACT ASSESSMENT (titled) dated prepared by XXXX permit# (WHERE RELEVANT). The (name of applicant) INVITES YOU TO A PUBLIC MEETING FOR name of project and brief description of change to proposal of (location)

THE PUBLIC IS INVITED TO PARTICIPATE IN THE MEETING BY WAY OF ASKING QUESTIONS RELATING TO THE PROPOSED AMENDMENT TO THE PROJECT PROPOSAL.

VENUE:
DATE:
TIME:

A COPY OF THE (LIST DOCUMENTS TO BE CONSULTED) MAY BE CONSULTED AT THE:

For further information contact: applications@nepa.gov.jm

APPENDIX 6

STRUCTURE OF PRESENTATION - CONDUCTING SUBSEQUENT PUBLIC CONSULTATIONS

1. DETAILED DESCRIPTION OF PROJECT ORIGINALLY PROPOSED/APPROVED (IF PERMIT GRANTED)

2. CHANGES TO THE PROPOSAL

3. DETAILS OF IMPACTS IDENTIFIED BASED ON THE CHANGES

4. DESCRIPTION OF PROPOSED MITIGATION MEASURES

5. RESPONSE TO ANY ISSUES RAISED PRIOR TO PUBLIC CONSULTATION (MEDIA, WRITTEN QUERY ETC.)

APPENDIX 7

AGENDA - CONDUCTING SUBSEQUENT PUBLIC CONSULTATIONS

1. WELCOME AND INTRODUCTION
2. STATEMENT BY THE NATIONAL ENVIRONMENT & PLANNING AGENCY
3. PRESENTATION OF TECHNICAL DOCUMENTS RELATED TO THE CHANGE IN THE PROPOSAL AND MEASURES TO MINIMIZE IMPACTS
4. QUESTION AND ANSWER SESSION
5. CLOSING REMARKS

Appendix 4 – Hydrolab DS-5 Multiprobe Calibration Test Sheet

DATE: 10-2-12	DOCUMENT #: 19005-00-Tech_Series5_Instruc
PAGE: 1 OF 2	REVISION: 1

OTT Hydromet

Section A: **Series 5, and 5x Sonde Functional Test Data Sheet**

Service Request # WO-00241207	Customer CL ENVIRONMENTAL	Date Started 12-7-18
Housing Serial # 048757	Embedded Serial# 48757	Additional Driver Firmware:
Technician RO	Model: **Datasonde** ✓ 5 ✓ **Minisonde** 5x	LDO 2.98, TURB 2.12, PAR 1.02, DEP 100 2.13

Customer Display Information

I/D NA	DOM 012110	Baud Rate 19200	Security 2	SDI NA	TTY
Parameter	TIME	TEMP	PH	SPCond	ORP
Units		C	UNITS	mS/cm	mV
Parameter	DEP 100	PAR	TURB	LDO%	LDO
Units	METERS	uE/s/m	NTU	SAT	mg/L

For Sonde with Depth – Coefficients

A: -740.292	B: 2610.112	C: 15.69118	D: -3056.038
E: -.005767	F: -3.57118	G: 1187.84	H: 9.512107E-05
I: .002114	J: 1.793437	SER: 0.0	

FLUOROMETER OFFSETS

1ST NA	X10:	X1:
2ND	X10:	X1:

For Sonde with TDG or PAR – Coefficients

A: NA	**B:**	**C:**	**D:**
Local:	Ref:		

Performance, Test and Evaluation

Current MPL Rev-- 5.44 Upgrade to MPL Rev--	pH Electrolyte & Teflon Junction Replaced- Yes ✓ No NA	DO membrane Replaced Yes No NA ✓
Sensors cleaned –Yes ✓	RTC Battery Replaced Yes ✓ No	Desiccant Replaced –Yes ✓ No

Section B:

	Submission 1 Day 1	Submission Day
Customer Observations Verified / Customer Request	Y ✓ N N/A PT&E Upgrade	Y N N/A PT&E Upgrade
Set Time and Date	Yes ✓	Yes
Verified all hardware updates as current	Yes ✓	Yes
Total current draw. (Check all that apply) MPL PCB 40mA ✓ SC Turbidity 20mA ✓ LDO 80mA ✓ 4Beam Turbidity 10mA Flourometers: 1st 30mA 2nd 30mA 3rd 30mA PAR 10mA ✓ (Optimal Values not to exceed +20mA overall.)	170mA	
Current draw of circulator. (20 mA max. beyond previous values.)	NA	
Operation of self-cleaning motor verified—	P ✓ F NA	P F NA
Audio functions correctly	P ✓ F	P F
RTC sleep/wake-up test.	P ✓ F	P F

Additional Notes

1
19005-00-Tech_Series5_Instruc
Rev 1

DATE: 10-2-12	DOCUMENT #: 19005-00-Tech_Series5_Instruc
PAGE: 2 OF 2	REVISION: 1

Temp probe test at room temperature. 20.00 ° C (+/- 0.1)	Sonde Temp : 19.97 ° C	Sonde Temp : ° C
DO 100% sat integrity window verified at +50 mmHg over current bp. (Clark Cell only)	P F NA ✓	P F NA
DO 100% saturation calibration verified - local BP (+/- 0.2 mg/L Clark Cell) (+/- 0.1mg/L LDO)	Temp : 21.17 BP : 636.4 mg/L : 7.41 Drift +/- :	Temp : BP : mg/L : Drift +/- :
Scale Factor (0.7 -- 1.3) LDO Only	1.093	
Conductivity zero (air) calibration verified - (+/-.005mS)	.000	
Conductivity calibration verified – 1.412 mS/cm (± .04 mS) ✓ 12.856 mS/cm (± .2 mS) 47.6 mS/cm (± .2 mS)	12.86	
Conductivity linearity verified – .100 mS/cm (± .005 mS) ✓ .500 mS/cm (± .025 mS)	.505	
pH 7 buffer calibration verified– (+/- .2 pH)	7.00	
pH slope calibration verified at 10 units.	10.00	
ORP calibration verified at 21.45 ° C (+/- 20 mV)	436	
Turbidity - Calibration accepted & verified with DI Water (0.0 +/- 0.7 NTU)	.5	
Turbidity - Calibration accepted & verified at (100.0 +/- 1 NTU) with Hach StablCal	100	
Turbidity - Linearity verified with 40 NTU Hach StablCal – (+/- 4 NTU)	39.7	
Depth zero calibration verified – (.02 meters)	.00	
Depth Check verified – (+/- 0.03 meters) Tank depth: .50	.50	
Specific Ion NA Low C mV High C mV	Specific Ion NA Low C mV High C mV	Specific Ion NA Low C mV High C mV
N03- calibration verified	P F NA ✓	P F NA
NH4+ calibration verified	P F NA ✓	P F NA
Cl- calibration verified	P F NA ✓	P F NA
Chlorophyll 'a' calibration verified	P F NA ✓	P F NA
Rhodamine 'wt' calibration verified	P F NA ✓	P F NA
Blue-green Algae calibration verified	P F NA ✓	P F NA
PAR calibration verified	P ✓ F NA	P F NA
TDG calibration verified (+/- 2 mmHg)	P F NA ✓	P F NA
Logging/Sensor Stability Test	P ✓ F	P F
pH linearity verified at 4 units. (+/- 0.20 units)	4.02	
Battery pack setup and checked	P ✓ F NA	P F NA

Display, Baud Rate, Communications mode settings returned as received.	Yes ✓ No

Calibrated Test Equipment Used – Description	X-number
Power Supply	X- 8011
Fluke 1524 -- Reference Thermometer	X- 8244
DVM Digital Multimeter	X- 7240

Section C. Final Check-off Prior to Submitting for Estimate

Exterior is clean ✓	Hach Business System updated ✓
Clear pH 4 Buffer in storage cup ✓	Date Completed 12-8-18

2
19005-00-Tech_Series5_Instruc
Rev 1

Appendix 5 – Noise Calibration Certificates

Page 1 of 2

TSI INCORPORATED – OCONOMOWOC
1060 Corporate Center Drive, Oconomowoc, WI 53066 USA
tel 651 490 2811 + toll free 800 245 0779 + web www.tsi.com

Certificate of Calibration

Certificate No: 764862 0QI0110126

Submitted By: CL ENVIRONMENTAL CO
20 WINDSOR AVENUE
KINGSTON 5, JAMAICA

Serial Number:	0QI0110126	Date Received:	12/14/2018
Customer ID:		Date Issued:	12/17/2018
Model:	QC-10 CALIBRATOR	Valid Until:	12/17/2019
Test Conditions:		**Model Conditions:**	
Temperature:	18°C to 29°C	As Found:	OUT OF TOLERANCE
Humidity:	20% to 80%	As Left:	IN TOLERANCE
Barometric Pressure:	890 mbar to 1050 mbar		

SubAssemblies:

Description: **Serial Number:**

Calibration Procedure: 56V981

Reference Standard(s):

I.D. Number	Device	Last Calibration	Date Calibration Due
ET000176	FLUKE 45 MULTIMETER	2/22/2017	2/22/2019
ET0000556	B&K ENSEMBLE	6/23/2018	10/31/2019

Measurement Uncertainty:

+/- 1.1% ACOUSTIC (0.1DB) +/- 1.4% VAC +/- 0.012% HZ
Estimated at 95% Confidence Level (k=2)

Calibrated By: James Cullinane III 12/17/2018
JAMES CULLINANE III Service Technician

Reviewed/Approved By: Paul M. Wegmann 12/17/2018
Technical Manager/Deputy

This report certifies that all calibration equipment used in the test is traceable to NIST or other NMI, and applies only to the unit identified under equipment above. This report must not be reproduced except in its entirety without the written approval of 3M Detection Solutions.

098-393 Rev. B

An ISO 9001 Registered Company
ISO 17025 Accredited Calibration Laboratory

A2LA ACCREDITED Calibration Laboratory CERT# 1326.01

Page 2 of 2

TSI INCORPORATED – OCONOMOWOC
1060 Corporate Center Drive, Oconomowoc, WI 53066 USA
tel 651 490 2811 + toll free 800 245 0779 + web www.tsi.com

Certificate of Calibration

Certificate No: 764862 0QI0110126

(A) indicates out of tolerance condition

Test Type	Nominal	Tolerance-	Tolerance+		As Found	As Left	Unit
AC OUT/1kHz	1.000	0.950	1.050		1.008	1.000	VAC
Calibration	114.0	113.7	114.3	A	113.6	114.0	dB
Frequency	1000	980	1020		1003	1003	Hz

* indicates non accredited

098-393 Rev. B

An ISO 9001 Registered Company
ISO 17025 Accredited Calibration Laboratory

A2LA ACCREDITED Calibration Laboratory CERT# 1326.01

Brüel & Kjær
North America Inc.

The Bruel and Kjaer Calibration Laboratory
3079 Premiere Parkway Suite 120
Duluth, GA 30097
Telephone: 770-209-6907
Fax: 770-447-4033
Web site address: http://www.bksv.com

ACCREDITED
Calibration Certificate # 1568.01

CERTIFICATE OF CALIBRATION

No.: CAS-339049-C8X1P1-801 Page 1 of 2

CALIBRATION OF:

Calibrator: Brüel & Kjær Type 4231 IEC Class: 1 Serial No.: 3008614

CUSTOMER:

C.L. Environmental Company Ltd.
20 Windsor Avenue
Kingston 10 Jamaica

CALIBRATION CONDITIONS:

Environment conditions:

Air temperature:	23	°C
Air pressure:	98.29	kPa
Relative Humidity:	43	%RH

SPECIFICATIONS:

This document certifies that the acoustic calibrator as listed under "Type" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. Statements of compliance, where applicable, are based on calibration results falling within specified criteria with no reduction by the uncertainty of the measurements. The calibration of the listed transducer was accomplished using a test system which conforms to the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and guidelines of ISO 10012-1. /For "as received" and "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation. This Certificate and attached data pages shall not be reproduced, except in full, without written approval of the Bruel and Kjaer Calibration Laboratory-Duluth, GA. Results relate only to the items tested. The transducer has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants. The acoustic calibrator has been calibrated in accordance with the requirements as specified in IEC60942.

PROCEDURE:

The measurements have been performed with the assistance of Brüel & Kjær acoustic calibrator calibration application Software version 2.3.4 Type 7794 using calibration procedure 4231 Complete

RESULTS:

[X] "As Received" Data: Within Acceptance Criteria
[X] "Final" Data : Within Acceptance Criteria
[ ] "As Received" Data: Outside Acceptance Criteria
[ ] "Final" Data : Outside Acceptance Criteria

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with EA-4/02from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the calibrator under calibration.

Date of Calibration: 31 October, 2018 Certificate issued: 31 October, 2018

Debra Wilson
Calibration Technician

Quality Representative

Brüel & Kjær
North America Inc.

CERTIFICATE OF CALIBRATION

No.: CAS-339049-C8X1P1-801

Type: 4231 Serial No.: 3008614 Page 2 of 2

Sound Pressure Levels

All stated values are valid at environmental reference conditions

Nominal Level [dB]	Accept Limit Lower [dB]	Accept Limit Upper [dB]	Measured Level [dB]	Measurement Uncertainty [dB]
94	93.80	94.20	94.00	0.12
114	113.80	114.20	113.97	0.12

Frequency

Nominal Frequency [Hz]	Accept Limit Lower [Hz]	Accept Limit Upper [Hz]	Measured Frequency [Hz]	Measurement Uncertainty [Hz]
1000	999.00	1001.00	999.98	0.10

Total Distortion*

Distortion mode: [X] TD* [ ] THD*

Calibration Level [dB]*	Accept Limit [%]*	Measured Distortion [%]*	Measurement Uncertainty [%]*
94	1.00	0.40	0.13
114	1.00	0.11	0.13

Environmental Reference Conditions:

Pressure: 101.3 kPa, Temperature: 23 °C, Relative Humidity: 50%

Instrument List

Type	Description	Serial no	Cal. date	Due date	Calibrated by	Trace number
3560	PULSE Analyzer	2723320	2018-10-22	2019-10-31	KC	CAS-335103-K3P9T8-301
9545	Transfer Microphone	3	2017-11-30	2018-11-30	WS	CAS-266536-L2C3Q6-701
4228	Reference Sound Source	2970961	2017-04-08	2019-04-08	William Shipman	CAS-212121-C8J1D8-708

During the calibration the calibrator has been loaded by the load volume of the Transfer Microphone. The load volumes for a number of different types of Transfer Microphones are listed in the table below.
For Brüel & Kjær Pistonphones types 4220 and 4228 the result of the SPL calibration has been corrected to be valid for a load volume of 1333 mm³ . For all other types the result is valid with the actual load volume.

Transfer Microphone Type	Fulfils standard IEC 61094-1 LS	Fulfils standard IEC 61094-4 WS	Load Volume 1" (1/2" mic including DP-0776)	Load Volume 1/2"
4180	yes	yes	1126 mm^3	43 mm^3
4192	-	yes	1273 mm^3	190 mm^3
9545	-	-	1333 mm^3	-

Condition "As Received":

GOOD

Comments

Appendix 6 – Perception Survey Questionnaires

PRINCESS HOTELS & RESORTS
INDUSTRY COVE, GREEN ISLAND, HANOVER
COMMUNITY QUESTIONNAIRE

DATE:____________________ **INTERVIEWER:**_______________

Princess Hotels & Resorts are desirous of developing a 2,034-room hotel in Industry Cove area which is located close to Green Island, Hanover on an area known as Industry Bay. The total property size is approximately 75.59 hectares (≈186.78 acres); however, room construction will be done on approximately 34 hectares (≈84 acres), just under a half of the total property size towards the coastline/beach area. As proposed, there will be four main hotel areas (each with multiple blocks) as well as the construction of fourteen over water suites. As part of the overall project will be the construction of one waste water treatment plant (to be done in two phases) as well as site drainage upgrades which will see the construction of retention pond(s) towards the south-west and north-east sections of the property. Proposed also is beach rehabilitation/construction. At this time no timeline for the project duration has been indicated.

COHORT DESCRIPTION

1. What is the name of this/your community? ___________________________
2. (i) Male (ii) Female
3. Age group (i) 18- 25 yrs (ii) 26-33 yrs (iii) 34-41 yrs (iv) 42 – 50 yrs (v) 51 – 60 yrs (vi) older than 60 yrs
4. Are you the head of your household (i) yes (ii) no
5. What is your current employment status? (i) self-employed (ii) have an employer (iii) unemployed (iv) retired
6. Including yourself, how many people live in your household? ____ (i) # of adults ____ (ii) # of children under 18 yrs ____
7. How long have you lived in your community? (i) <2 yrs (ii) 3-5 yrs (iii) 5- 10 yrs (iv)10-15 yrs (v) >15 yrs (vi) all your life
8. In the event of illness, where do you mainly obtain health care (write in name & location)?(i) Public Clinic______________ (ii) Public Hospital _________________(iii) Private Doctor __________________ (iv) Private Hospital________________
9. Do you suffer from any of the following conditions? (i). Asthma (ii). Sinusitis (iii) coughing (iv) congestion/bronchial problems (v) chest pains (vi) bouts of diarrhoea (vii) none
10. What is your average weekly income? (i) no income (ii) under \$6,200 per week (iii) \$6,200 per week (iv) \$6,201 - \$10,000 per week (v) \$10,001 - \$20,000 per week (vi) over \$20,000 per week (vii) refuse to answer
11. What is the highest level of education you completed? (Which was the last school you attended) (i) None (ii) Primary/All Age (iii) Some High School (iv) High School (v) College (vi) University (vii) HEART/Vocational training institute
12. Is there anyone in your household attending school at this time? (i) yes (ii) no
    a. What school(s) do they attend (i) infant/basic (ii) primary/all age (iii) high school (iv) college (v) University (vi) HEART/ Vocational Training Institute
13. Are there any recreational centres/spaces in your community? (i). Yes (ii) No
    a. **If yes** please give name and type ______________________________

PERCEPTION

14. Have you ever heard of the Princess Hotels and Resorts? (i) yes; (ii) no
15. Did you know that Princess Hotels and Resorts is proposing to develop a 2,034-room hotel in Industry Cove area which is located close to Green Island, Hanover on an area known as Industry Bay? (i) yes(ii) no
    a. **If yes** What have you heard? ____
    b. **If yes**, how were you made aware? (i) Newspaper (ii) Television (iii) Radio (iv) Community meeting (v) Word of mouth (vi) Other ------------------------------
16. Did you know that Princess Hotels and Resorts as part of the project is proposing to develop a waste water treatment plant on the property? (i) yes(ii) no
    a. **If yes** What have you heard? ____
    b. **If yes**, how were you made aware? (i) Newspaper (ii) Television (iii) Radio (iv) Community meeting (v) Word of mouth (vi) Other ------------------------------
17. Did you know that Princess Hotels and Resorts as part of the project is proposing to develop a drainage system for the property which will result in the construction of retention pond(s) on the property? (i) yes(ii) no
    a. **If yes** What have you heard? ____
    b. **If yes**, how were you made aware? (i) Newspaper (ii) Television (iii) Radio (iv) Community meeting (v) Word of mouth (vi) Other ------------------------------
18. Have there been any problems/issues in the Industry Bay Area proposed for the hotel construction? (i) yes (ii) no (iii) don't know
    a. **If yes** what were/are the issues ____

September 2019

19. Do you have any concerns about the project as proposed? (i) yes; (ii) no (iii) not sure/don't know
    a. **If yes**, what are they? ____

    ____

20. Do you depend on this property, coastline area or the marine environment proposed for the hotel construction for any type of business or activity? (i) yes; (ii) no
    a. **If yes** for what purpose ____
21. Do you know of anyone who depends on this property, coastline area or the marine environment proposed for the hotel construction for any type of business or activity? (i) yes; (ii) no
    a. **If yes** for what purpose ____
22. Do you think this project will affect your life (i) positively or (ii) negatively? (iii) not at all (iv) not sure/don't know
    a. **If positive** how so? ____
    b. **If negative** how so?____
23. Do you think this project will affect the marine environment and coastline (i) positively (ii) negatively (iii) not at all (iv) not sure
    a. **If positive** how so? ____
    b. **If negative** how so?____
24. Do you think this project will affect the general environment (i) positively (ii) negatively? (iii) not at all (iv) not sure
    a. **If positive** how so? ____
    b. **If negative** how so?____
25. Do you think this project will impact flooding in nearby areas? (i) positively (ii) negatively (iii) not at all (iv) not sure
    a. **If positive** how so? ____
    b. **If negative** how so?____

HOUSING, HEALTH AND SOCIAL SERVICES

26. Do you _______ the house you live in? (i) Own (ii) Lease (iii) Rent (iv) Government Own (v) Squat (vi) Family own (vii) Other, specify ____________

27. Do you ________ the land on which your house is located?
    (i) Own (ii) Lease (iii) Squat on (iv) Family Owned (v) Government Owned (vi) Other, specify ______________

28. What type of construction material is your residence made from?
    a. **Walls:** (i) Concrete and blocks (ii) Wood/Board (iii) Zinc (iv) Other specify________
    b. **Roof:** (i) Metal sheeting (zinc) (ii) Concrete (iii)Wood (iv) Other specify________
29. How many of the following rooms does your residence have? (i) Bedrooms _______ (ii) Bathrooms ________

30. What type of toilet facility do you have? (i) Water Closet (ii) Pit Latrine (iii) None (iv)Other, specify ____________

31. What does your household use for lighting? (i) Electricity (ii) Kerosene oil (iii) Gas (iv) Solar (v) Other, specify ___________

32. What (type of fuel does the household) do you **use most** for cooking? (i) Gas (ii) Electricity (iii)Wood (iv)Coal (v)Other, specify _____________

33. What is the main source of domestic water supply for the household? (i) Public piped water into dwelling (ii) Private Tank (iii) Community Tank (iv) Government Water Trucks (free) (v)Public Standpipe (vi). Private Water Trucks (paid) (vii) Spring or River (viii) Other, specify________

34. Do you have any problems with domestic/household water supply (i) yes (ii) no
    a. **If yes**, what is the problem? (i) no water at all (ii) no pipes run to the area (iii) irregular water supply (iv) low water pressure (v) other ______________________________

    b. **If yes** how do you cope with the problem (i) collect rain water (ii) buy water (iii) collect water from a spring/river (iv) water truck supplies water (v) community standpipe (vi) other _______________________

35. Do you have access to a residential telephone (land line)?(i) yes (ii) no
    a. **If no**, do you have a mobile/cell phone? (i) yes (ii) no
    b. **If no**, do you know of anyone having a residential telephone nearby? (i) yes (ii) no

36. What is the main method of garbage disposal for your household? (i) Public Garbage Truck (ii) Private Collection (iii) Burn (iv) Other specify ________
    a. **If public garbage truck**, how often do trucks pick up garbage? (i) once per week (ii) twice per week (iii) every 2 weeks (iv) 1 time per month (v) less than once per month

NATURAL HAZARDS & SOCIAL AMENITIES

37. Are there problems with frequent flooding in your community? (i) Yes (ii) No (iii) don't know
    a. **If yes** when does flooding occur (i) each time it rains (ii) only times of heavy rains (iii) during hurricanes
    b. **If yes** how often does it rain to cause flooding? (i) once weekly (ii) once monthly (iii) once in three months (iv) once in six months (v) once in a year (vi) less than once in a year
    c. **If yes** where are the affected areas? ____

    d. **If yes** how high does the water level rise? (i) less than 1 foot (ii) 1-5 ft (iii) more than 5 ft

September 2019

38. Are there problems with frequent flooding at or near the proposed area? (i) Yes (ii) No (iii) not sure/don't know
    a. **If yes** when does flooding occur (i) each time it rains (ii) only times of heavy rains (iii) during hurricanes
    b. **If yes** how often does it rain to cause flooding? (i) once weekly (ii) once monthly (iii) once in three months (iv) once in six months (v) once in a year (vi) less than once in a year
    c. **If yes** where are the affected areas? ____
    d. **If yes** how high does the water level rise? (i) less than 1 foot (ii) 1-5 ft (iii) more than 5 ft
39. Is the proposed area affected by tidal changes such as storm surge/sea level rise? (i) yes (ii) no (iii)not sure/don't know
40. Has the proposed area been affected by beach erosion in the past? (i) yes (ii) no (iii)not sure/don't know
41. Do you know of any site or area nearby the proposed site considered to be (i) a protected area/ area of environmental importance (ii) historic area (iii) or other area of national importance? (i) Yes (ii) No (iii) don't know
    a. **If yes** please give us as much detail as you can on this area ____________________________________
42. Is there anything in particular about your area that you would like to tell us?

    ____

Signature of Interviewer: ....

Thank You for your time.

September 2019

PRINCESS HOTELS & RESORTS
INDUSTRY COVE, GREEN ISLAND, HANOVER
FISHERS QUESTIONNAIRE

DATE:___________________ **INTERVIEWER:**_______________

LOCATION:___________________

Princess Hotels & Resorts are desirous of developing a 2,034-room hotel in Industry Cove area which is located close to Green Island, Hanover on an area known as Industry Bay. The total property size is approximately 75.59 hectares (≈186.78 acres); however, room construction will be done on approximately 34 hectares (≈84 acres), just under a half of the total property size towards the coastline/beach area. As proposed, there will be four main hotel areas (each with multiple blocks) as well as the construction of fourteen over water suites. As part of the overall project will be the construction of one waste water treatment plant (to be done in two phases) as well as site drainage upgrades which will see the construction of retention pond(s) towards the south-west and north-east sections of the property. Proposed also is beach rehabilitation/construction. At this time no timeline for the project duration has been indicated.

COHORT DESCRIPTION

1. (i) Male (ii) Female
2. Age group i) 18- 25 yrs (ii) 26-33 yrs (iii) 34-41 yrs (iv) 42 – 50 yrs (v) 51 – 60 yrs (vi) older than 60 yrs
3. Are you a fisher (man/woman) (i) yes (ii) no
4. Is anyone else in your household a fisher (man/woman) (i) yes (ii) no
5. **If yes** how many persons i) one (ii) two (iii) three (iv) four (v) five (vi) more than 5
6. Are you a fish vendor (i) yes (ii) no
7. Is anyone else in your household a fish vendor (i) yes (ii) no
8. **If yes** how many persons(i) one (ii) two (iii) three (iv) four (v) five (vi) more than 5
9. What is your current employment status? (i) self-employed (ii) have an employer (iii) unemployed (iv) retired
10. How long have you been a fisher or fish vendor?
    (i) 0 - 5 yrs. (ii) 6 - 11 yrs. (iii) 12 - 17 yrs. (iv) 18 - 24 yrs. (v) 25 - 30yrs. (vi) Over 30 yrs.
11. Where do you sell fish? ____
12. Where do you fish? (i) nearshore/inner harbour (ii) deep sea 1-5 miles from shore (iii) deep sea more than 5 miles from shore
13. What is/are the name(s) of the areas that you fish? ____
14. What do you use for fishing (i) line (ii) spear (iii) net (iv)fish pot (v) other ________________
15. What type of vessel do you use for fishing (i) canoe without engine (ii) canoe with engine (iii) large boat with net (trawler) (iv) other ____
    a. If your vessel has an engine how many engines does it have_________ and what is the engine size _________
16. Including you how many persons work on your vessel? (i) one (ii) two (iii) 3 (iv) four (v) five (vi) more than 5
17. Including you does anyone else sell fish with you? (i) yes (ii) no
    a. **If yes** how many persons? (i) one (ii) two (iii) three (iv) four (v) five (vi) more than 5
18. How many times per week do you sell fish? (i) one (ii) two (iii) three (iv) four (v) five (vi) more than 5
19. How many times per week do you go fishing? (i) one (ii) two (iii) three (iv) four (v) five (vi) more than 5
20. What species/ type of fish do you catch? ____
    ____
21. How many pounds of fish do you usually catch each time you go fishing? (i) less than 10lbs (ii) 11 – 20 lbs (iii) 21 -50lbs (iv) 51-100 lbs (v) more than 100 lbs
22. How has your pound catch/ sale/ yield changed over time? (i) increase (ii) decrease (iii) no change
23. Is there a time of year/season when the fish catch/ sale is high? (i) yes (ii) no
    a. **If yes** explain ____
24. Over time have you noticed a change in the size and types of fish you catch or sell? (i) yes increase (ii) yes decrease (ii) no change?
    a. **If yes** what do you think is the reason (s)? ______________________________
25. What is the average weekly income of fish sales?
    (i) Below $1000 ii) $1001 - $2000 (iii) $2001 - $4000 (iv) $4000 - $6000 (v) $6001 - $8000 (vi) Over $8000
26. Have you noticed a change in money earned from sales? (i) yes increase (ii) yes decrease (ii) no change
    If yes what do you think is the reason (s)? ______________________________

PERCEPTION

27. Have you ever heard of the Princess Hotels and Resorts? (i) yes; (ii) no
28. Did you know that Princess Hotels and Resorts is proposing to develop a 2,034-room hotel in Industry Cove area which is located close to Green Island, Hanover on an area known as Industry Bay? (i) yes(ii) no
    a. **If yes** What have you heard? ____
    b. **If yes**, how were you made aware? (i) Newspaper (ii) Television (iii) Radio (iv) Community meeting (v) Word of mouth (vi) Other ------------------------------
29. Did you know that Princess Hotels and Resorts as part of the project is proposing to develop a waste water treatment plant on the property? (i) yes(ii) no
    a. **If yes** What have you heard? ____
    b. **If yes**, how were you made aware? (i) Newspaper (ii) Television (iii) Radio (iv) Community meeting (v) Word of mouth (vi) Other ------------------------------
30. Did you know that Princess Hotels and Resorts as part of the project is proposing to develop a drainage system for the property which will result in the construction of retention pond(s) on the property? (i) yes(ii) no
    a. **If yes** What have you heard? ____
    b. **If yes**, how were you made aware? (i) Newspaper (ii) Television (iii) Radio (iv) Community meeting (v) Word of mouth (vi) Other ------------------------------
31. Have there been any problems/issues in the Industry Bay Area proposed for the hotel construction? (i) yes (ii) no (iii) don't know
    a. **If yes** what were/are the issues ____
32. Do you have any concerns about the project as proposed? (i) yes; (ii) no (iii) not sure/don't know
    a. **If yes**, what are they? ____
    ____
33. Do you think this project will affect your life (i) positively or (ii) negatively? (iii) not at all (iv) not sure/don't know
    a. **If positive** how so? ____
    b. **If negative** how so?____
34. Do you think this project will affect the marine environment and coastline (i) positively (ii) negatively (iii) not at all (iv) not sure
    a. **If positive** how so? ____
    b. **If negative** how so?____
35. Do you think this project will affect the general environment (i) positively (ii) negatively? (iii) not at all (iv) not sure
    a. **If positive** how so? ____
    b. **If negative** how so?____
36. Do you think this project will impact flooding in nearby areas? (i) positively (ii) negatively (iii) not at all (iv) not sure
    a. **If positive** how so? ____
    b. **If negative** how so?____

NATURAL HAZARDS

37. Are there problems with frequent flooding at or near the proposed area? (i) Yes (ii) No (iii) not sure/don't know
    a. **If yes** when does flooding occur (i) each time it rains (ii) only times of heavy rains (iii) during hurricanes
    b. **If yes** how often does it rain to cause flooding? (i) once weekly (ii) once monthly (iii) once in three months (iv) once in six months (v) once in a year (vi) less than once in a year
    c. **If yes** where are the affected areas? ____
    d. **If yes** how high does the water level rise? (i) less than 1 foot (ii) 1-5 ft (iii) more than 5 ft
38. Is the proposed area affected by tidal changes such as storm surge/sea level rise? (i) yes (ii) no (iii)not sure/don't know
39. Has the proposed area been affected by beach erosion in the past? (i) yes (ii) no (iii)not sure/don't know
40. Do turtles nest at or near the proposed area? (i) Yes (ii) No (iii) not sure/don't know
    a. **If yes** where do they nest/ please give us as much detail as you can on this area? ____________________
    ____
41. Is there any area considered to be a fishing sanctuary or nursery area at or nearby the proposed site? (i) Yes (ii) No (iii) not sure/don't know
    a. **If yes** please give us as much detail as you can on this area ____________________
42. **Is there anything in particular that you would like to tell us?**____________________
    ____

Any other comments:

Signature: ....
Interviewer

15.0 GLOSSARY OF TECHNICAL TERMS

A

ARMOR UNIT OR STONE
A relatively large quarrystone or concrete shape that is selected to fit specified geometric characteristics and density. It is usually of nearly uniform size and usually large enough to require individual placement. In normal cases it is used as primary wave protection and is placed in thicknesses of at least two units.

B

BASIN
A depressed area with no surface outlet, such as a lake basin or an enclosed sea.

BATHYMETRY
The measurement of water depths in oceans, seas, and lakes; also information derived from such measurements.

BAY
A recess in the shore or an inlet of a sea between two capes or headlands, not as large as a gulf but larger than a COVE.

BEACH
The zone of unconsolidated material that extends landward from the low water line to the place where there is marked change in material or physiographic form, or to the line of permanent vegetation (usually the effective limit of storm waves). The seaward limit of a beach--unless otherwise specified--is the mean low water line. A beach includes foreshore and backshore.

BEACH EROSION
The carrying away of beach materials by wave action, tidal currents, littoral currents, or wind.

BEACH PROFILE
A cross-section taken perpendicular to a given beach contour; the profile may include the face of a dune or sea wall; extend over the backshore, across the foreshore, and seaward underwater into the NEARSHORE zone.

BED
The bottom of a watercourse, or any body of water.

BENEFITS
The asset value of a scheme, usually measured in terms of the cost of damages avoided by the scheme, or the valuation of perceived amenity or environmental improvements

BENTHIC
Pertaining to the sub-aquatic bottom.

BIOLOGICAL OXYGEN DEMAND (BOD)
The amount of oxygen taken up by aerobic microbes that decompose organic matter in a unit volume of water over a given time. It is used as a measure of the degree of organic pollution of water. The

BOULDER
A rounded rock more than 256 mm (10 inch) in diameter; larger than a cobblestone. See SOIL CLASSIFICATION.

BREAKING
Reduction in wave energy and height in the surf zone due to limited water depth

BREAKWATER
A barrier built out at sea to protect the coastline from the force of a WAVE or STORM SURGE.

C

CHANNEL
(1) A natural or artificial waterway of perceptible extent which either periodically or continuously contains moving water, or which forms a connecting link between two bodies of water. (2) The part of a body of water deep enough to be used for navigation through an area otherwise too shallow for navigation. (3) A large strait, as the English Channel. (4) The deepest part of a stream, bay, or strait through which the main volume or current of water flows.

CLAY
A fine grained, plastic, sediment with a typical grain size less than 0.004 mm. Possesses electromagnetic properties which bind the grains together to give a bulk strength or cohesion. See SOIL CLASSIFICATION.

CLIMATE
The characteristic weather of a region, particularly regarding temperature and precipitation, averaged over some significant internal of time (years).

COAST
(1) A strip of land of indefinite width (may be several kilometers) that extends from the SHORELINE inland to the first major change in terrain features. (2) The part of a country regarded as near the coast.

COASTAL AREA
The land and sea area bordering the SHORELINE.

COASTAL ZONE
The coastal zone may be simply defined as that transitional area between the land and sea. The coastal zone includes beaches and wetlands. Jamaica's coastal zone has important infrastructure including our ports, airports, oil refinery, road and electricity networks, and many towns and cities. It also includes important tourism related infrastructure (hotels and attractions). Coastal wetlands are valuable habitats for fish and other marine life. Coastal zones provide a buffer from flooding due to storm surges due to hurricanes.[11]

COASTAL ZONE MANAGEMENT
The integrated and general development of the coastal zone. Coastal Zone Management is not restricted to coastal defense works, but includes also a development in economical, ecological and social terms. Coastline Management is a part of Coastal Zone Management.

COASTLINE
(1) Technically, the line that forms the boundary between the coast and the shore. (2) Commonly, the line that forms the boundary between the land and the water, esp. the water of a sea or ocean. The SHORELINE.

CONTOUR
A line on a map or chart representing points of equal elevation with relation to a DATUM. It is called an ISOBATH when connecting points of equal depth below a datum. Also called DEPTH CONTOUR.

CORAL
Corals are marine invertebrates in class Anthozoa of phylum Cnidaria typically living in compact colonies of many identical individual "polyps". The group includes the important reef builders that inhabit tropical oceans and secrete calcium carbonate to form a hard skeleton.

CORAL REEF

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[11] http://myspot.mona.uwi.edu/physics/sites/default/files/physics/uploads/02_CCAndCoastal%20Zones2.pdf

A coral-algal mound or ridge of in-place coral colonies and skeletal fragments, carbonate sand, and organically-secreted calcium carbonate. A coral reef is built up around a wave-resistant framework, usually of older coral colonies.

COVE
A small, sheltered BAY. Smaller than a BAY.

CREST
Highest point on a beach face or BREAKWATER.

CURRENT
(1) The flowing of water, or other liquid or gas. (2) That portion of a stream of water which is moving with a velocity much greater than the average or in which the progress of the water is principally concentrated. (3) Ocean currents can be classified in a number of different ways. Some important types include the following: (1) Periodic - due to the effect of the tides; such Currents may be rotating rather than having a simple back and forth motion. The currents accompanying tides are known as tidal currents; (2)Temporary - due to seasonal winds; (3) Permanent or ocean - constitute a part of the general ocean circulation. The term DRIFT CURRENT is often applied to a slow broad movement of the oceanic water; (4) Nearshore - caused principally by waves breaking along a shore.

CYCLONE
A system of winds that rotates about a center of low atmospheric pressure. Rotation is clockwise in the Southern Hemisphere and anti-clockwise in the Northern Hemisphere. In the Indian Ocean, the term refers to the powerful storms called HURRICANES in the Atlantic.

D

DECIBELS (DB)
Is a dimensionless unit used to report sound pressure level (SPL or Lp). Decibels are used to represent the wide pressure range a human ear can detect. It is a logarithmic scale is used to report sound pressures.

DEEP WATER
Water so deep that surface waves are little affected by the ocean bottom. Generally, water deeper than one-half the surface wavelength is considered deep water. Compare SHALLOW WATER.

DEGRADATION
The geologic process by means of which various parts of the surface of the earth are worn away and their general level lowered, by the action of wind and water.

DENSITY
Mass (in kg) per unit of volume of a substance; kg/m3. For pure water, the density is 1000 kg/m3, for seawater the density is usually more. Density increases with increasing salinity, and decreases with increasing temperature. More information can be found in "properties of seawater". For stone and sand, usually a density of 2600 kg/m3 is assumed. Concrete is less dense, in the order of 2400 kg/m3. Some types of basalt may reach 2800 kg/m3. For sand, including the voids, one may use 1600 kg/m3, while mud often has a density of 1100 - 1200 kg/m3.

DEPENDENCY RATIOS
It is the portion of a population which is composed of dependents (people who are too young or too old to work). The dependency ratio is equal to the number of individuals aged below 15 or above 64 divided by the number of individuals aged 15 to 64, expressed as a percentage.

DEPRESSION
A general term signifying any depressed or lower area in the ocean floor.

DEPTH
The vertical distance from a specified datum to the sea floor.

DESIGN STORM

A hypothetical extreme storm whose waves coastal protection structures will often be designed to withstand. The severity of the storm (i.e. return period) is chosen in view of the acceptable level of risk of damage or failure. A DESIGN STORM consists of a DESIGN WAVE condition, a design water level and a duration.

DISCHARGE
The volume of water per unit of time flowing along a pipe or channel.

DISPERSION
Pattern of geographic distribution of individuals within a species. (2) Distortion of the shape of a seismic wave train or ocean wave train because of variations of velocity with frequency.

DREDGING
The cleaning out of an area by scooping out mud, silt, rock etc.

DREDGE SPOIL
The contents of DREDGING (mud, silt, rock etc.).

DURATION
In wave forecasting, the length of time the wind blows in nearly the same direction over the FETCH (generating area).

E

ECHO SOUNDER
An electronic instrument used to determine the depth of water by measuring the time interval between the emission of a sonic or ultrasonic signal and the return of its echo from the bottom.

ECOSYSTEM
The living organisms and the nonliving environment interacting in a given area, encompassing the relationships between biological, geochemical, and geophysical systems.

ELEVATION
The vertical distance from mean sea level or other established datum plane to a point on the earth's surface; height above sea level. Although sea floor elevation below msl should be marked as a negative value, many charts show positive numerals for water depth.

EMBANKMENT
Fill material, usually earth or rock, placed with sloping sides and with a length greater than its height. Usually an embankment is wider than a dike.

ENTEROCOCCUS
A group of bacteria normally present in the intestinal tracts of humans and other warm-blooded animals.

ENTRANCE
The avenue of access or opening to a navigable channel or inlet.

EROSION
The wearing away of land by the action of natural forces. On a beach, the carrying away of beach material by wave action, tidal currents, littoral currents, or by deflation.

F

FAECAL COLIFORM
A group of bacteria normally present in large numbers in the intestinal tracts of humans and other warm-blooded animals. Frequently used as an indicator of sewage pollution.

FAUNA
The entire group of animals found in an area.

FILTER
Intermediate layer, preventing fine materials of an underlayer from being washed through the voids of an upper layer.

FLOOD
(1) Period when tide level is rising; often taken to mean the flood current which occurs during this period (2) A flow beyond the carrying capacity of a channel.

FLORA
The entire group of plants found in an area.

FLUSHING
To reduce stagnation by allowing large amounts of water to pass through

FORESHORE
The part of the shore, lying between the crest of the seaward berm (or upper limit of wave wash at high tide) and the ordinary low-water mark, that is ordinarily traversed by the uprush and backrush of the waves as the tides rise and fall. See BEACH FACE.

FORE REEF
The fore-reef is found on the oceanic side of the reef crest. It slopes downwards, sometimes to great depths. This is where coral diversity of highest.

G

GEOGRAPHICAL INFORMATION SYSTEM (GIS)
Database of information which is geographically referenced, usually with an associated visualization system.

GEOMORPHOLOGY
(1) That branch of physical geography which deals with the form of the Earth, the general configuration of its surface, the distribution of the land, water, etc. (2) The investigation of the history of geologic changes through the interpretation of topographic forms.

GEOTEXTILE
A permeable textile material used to increase soil stability, provide erosion control or aid in drainage.

GLOBAL POSITIONING SYSTEM (GPS)
A navigational and positioning system developed by the U.S. Department of Defense, by which the location of a position on or above the Earth can be determined by a special receiver at that point interpreting signals received simultaneously from several of a constellation of special satellites.

GRADIENT
(1) A measure of slope (soil- or water-surface) in meters of rise or fall per meter of horizontal distance. (2) More general, a change of a value per unit of distance, e.g. the gradient in longshore transport causes erosion or accretion. (3) With reference to winds or currents, the rate of increase or decrease in speed, usually in the vertical; or the curve that represents this rate.

GRADING
Distribution, with regard to size or weight, of individual stones within a bulk volume; heavy, light and fine grading are distinguished.

GRAVEL
Unconsolidated natural accumulation of rounded rock fragments coarser than sand but finer than pebbles (2-4 mm diameter).

GROYNE
Narrow, roughly shore-normal structure built to reduce longshore currents, and/or to trap and retain littoral material. Most groins are of timber or rock and extend from a SEAWALL, or the backshore, well onto the foreshore and rarely even further offshore.

H

HINDCASTING
In wave prediction, the retrospective forecasting of waves using measured wind information.

HURRICANE
An intense tropical cyclone in which winds tend to spiral inward toward a core of low pressure, with maximum surface wind velocities that equal or exceed 33.5 m/sec (75 mph or 65 knots) for several minutes or longer at some points. TROPICAL STORM is the term applied if maximum winds are less than 33.5 m/sec but greater than a whole gale (63 mph or 55 knots). Term is used in the Atlantic, Gulf of Mexico, and eastern Pacific.

J

JETTY
A small pier at which boats can dock or be moored.

L

LANDMARK
A conspicuous object, natural or artificial, located near or on land, which aids in fixing the position of an observer.

LIGHT EXTINCTION
The loss of light throughout the water column with increasing depth.

LOAD
The quantity of sediment transported by a current. It includes the suspended load of small particles and the BED LOAD of large particles that move along the bottom.

LOW WATER (LW)
The minimum height reached by each falling tide. Nontechnically, also called LOW TIDE.

M

MANGROVE
A tree or shrub which grows in tidal, chiefly tropical, coastal swamps, having numerous tangled roots that grow above ground and form dense thickets.

MEAN SEA LEVEL
The average height of the surface of the sea for all stages of the tide over a 19-year period, usually determined from hourly height readings. Not necessarily equal to MEAN TIDE LEVEL. It is also the average water level that would exist in the absence of tides.

MORPHOLOGY
River/estuary/lake/seabed form and its change with time.

MUD
A fluid-to-plastic mixture of finely divided particles of solid material and water.

N

NEARSHORE

(1) In beach terminology an indefinite zone extending seaward from the SHORELINE well beyond the BREAKER ZONE. (2) The zone which extends from the swash zone to the position marking the start of the offshore zone, typically at water depths of the order of 20 m.

NOISE
Noise is unwanted sound without agreeable musical quality. It is unwanted /undesired sound or sound in the wrong place at the wrong time. It is considered a pollutant and can be measured.

NOURISHMENT
The process of replenishing a beach. It may occur naturally by longshore transport, or be brought about artificially by the deposition of dredged materials or of materials trucked in from upland sites.

O

OFFSHORE
(1) In beach terminology, the comparatively flat zone of variable width, extending from the SHOREFACE to the edge of the CONTINENTAL SHELF. It is continually submerged. (2) The direction seaward from the shore. (3) The zone beyond the nearshore zone where sediment motion induced by waves alone effectively ceases and where the influence of the sea bed on wave action is small in comparison with the effect of wind. (4) The breaker zone directly seaward of the low tide line.

ONSHORE
A direction landward from the sea.

P

PAVEMENT
Flat, low-relief or sloping solid carbonate rock with little or no fine-scale rugosity that is covered with algae, hard coral, gorgonians, zooanthids or other sessile vertebrates that are dense enough to partially obscure the underly-ing surface. On less colonized Pavement features, rock may be covered by a thin sand veneer.

PEAK PERIOD
The wave period determined by the inverse of the frequency at which the wave energy spectrum reaches its maximum.

PHASE
In surface wave motion, a point in the period to which the wave motion has advanced with respect to a given initial reference point.

PHOTOSYNTHETICALLY ACTIVE RADIATION (PAR)
The amount of light available for photosynthesis, which is light in the 400 to 700 nanometer wavelength range.

PM 10
These are airborne particles that fall between 2.5 and 10 micrometers in diameter. They are considered coarse particles which are generated from sources such as crushing or grinding operations, and dust stirred up by vehicles traveling on roads.

PM 2.5
These are airborne particles that have diameters below 2.5 micrometres. Sources of these fine particles include all types of combustion, including motor vehicles, power plants, residential wood burning, forest fires, agricultural burning, and some industrial processes.

POPULATION DENSITY
The number of persons per square kilometre or acre of land area.

PROBABILITY

The chance that a prescribed event will occur, represented by a number (p) in the range 0 - 1. It can be estimated empirically from the relative frequency (i.e. the number of times the particular event occurs, divided by the total count of all events in the class considered).

R

REEF
An offshore consolidated rock hazard to navigation, with a least depth of about 20 meters (10 fathoms) or less. Often refers to coral FRINGING REEFS in tropical waters

RETURN PERIOD
Average period of time between occurrences of a given event.

REVETMENT
A retaining wall made of ARMOU STONE, supporting or protecting COASTLINE.

ROCK
(1) An aggregate of one or more minerals; or a body of undifferentiated mineral matter (e.g., obsidian). The three classes of rocks are: (a) Igneous – crystalline rocks formed from molten material. Examples are granite and basalt. (b) Sedimentary – resulting from the consolidation of loose sediment that has accumulated in layers. Examples are sandstone, shale and limestone. (c) Metamorphic – formed from preexisting rock as a result of burial, heat, and pressure. (2) A rocky mass lying at or near the surface of the water or along a jagged coastline, especially where dangerous to shipping.

S

SALINITY
Number of grams of salt per thousand grams of sea water, usually expressed in parts per thousand (symbol: ‰).

SAND
Sediment particles, often largely composed of quartz, with a diameter of between 0.062 mm and 2 mm, generally classified as fine, medium, coarse or very coarse. Beach sand may sometimes be composed of organic sediments such as calcareous reef debris or shell fragments.

SEA
(1) A large body of salt water, second in rank to an ocean, more or less landlocked and generally part of, or connected with, an ocean or a larger sea. Examples: Mediterranean Sea; South China Sea. (2) Waves caused by wind at the place and time of observation. (3) State of the ocean or lake surface, in

SEA GRASS

Members of marine seed plants that grow chiefly on sand or sand-mud bottom. They are most abundant in water less than 9 m deep. The common types are: Turtle grass (Thalasia), Manatee grass (Syringodium) and Eel grass (Zostera).

SEA LEVEL
See MEAN SEA LEVEL.

SEA LEVEL RISE
The long-term trend in MEAN SEA LEVEL.

SEAWALL
A barrier built out at sea to protect the coastline from the force of a WAVE or STORM SURGE.

SEDIMENT
(1) Loose, fragments of rocks, minerals or organic material which are transported from their source for varying distances and deposited by air, wind, ice and water. Other sediments are precipitated from

the overlying water or form chemically, in place. Sediment includes all the unconsolidated materials on the sea floor. (2) The fine grained material deposited by water or wind.

SETUP, WAVE
Super elevation of the water surface over normal surge elevation due to onshore mass transport of the water by wave action alone.

SETUP, WIND
See WIND SETUP.

SHALLOW WATER
(1) Commonly, water of such a depth that surface waves are noticeably affected by bottom topography. It is customary to consider water of depths less than one-half the surface wavelength as shallow water. See TRANSITIONAL ZONE and DEEP WATER. (2) More strictly, in hydrodynamics with regard to progressive gravity waves, water in which the depth is less than 1/25 the wavelength.

SHORE
The narrow strip of land in immediate contact with the sea, including the zone between high and low water lines. A shore of unconsolidated material is usually called a BEACH. Also used in a general sense to mean the coastal area (e.g., to live at the shore). Also sometimes known as the LITTORAL.

SHORELINE
The intersection of a specified plane of water with the shore or beach (e.g., the high water shoreline would be the intersection of the plane of mean high water with the shore or beach). The line delineating the shoreline on National Ocean Service nautical charts and surveys approximates the mean high water line (United States).

SIGNIFICANT WAVE
A statistical term relating to the one-third highest waves of a given wave group and defined by the average of their heights and periods. The composition of the higher waves depends upon the extent to which the lower waves are considered. Experience indicates that a careful observer who attempts to establish the character of the higher waves will record values which approximately fit the definition of the significant wave.

SIGNIFICANT WAVE HEIGHT
The average height of the one-third highest waves of a given wave group. Note that the composition of the highest waves depends upon the extent to which the lower waves are considered. In wave record analysis, the average height of the highest one-third of a selected number of waves, this number being determined by dividing the time of record by the significant period.

SILT
Sediment particles with a grain size between 0.004 mm and 0.062 mm, i.e. coarser than clay particles but finer than sand. See SOIL CLASSIFICATION.

SLOPE
The degree of inclination to the horizontal. Usually expressed as a ratio, such as 1:25, indicating one unit rise in 25 units of horizontal distance; or in a decimal fraction (0.04). Also called GRADIENT.

SOCIAL IMPACT AREA (SIA)
Estimated spatial extent of the proposed project's effect on surrounding communities, demarcated as a buffer of specified distance, e.g. 2 km from the proposed project.

SOIL
A layer of weathered, unconsolidated material on top of bed rock; in geologic usage, usually defined as containing organic matter and being capable of supporting plant growth.

SOUND
(1) (noun) a relatively long arm of the sea or ocean forming a channel between an island and a mainland or connecting two larger bodies, as a sea and the ocean, or two parts of the same body;

usually wider and more extensive than a STRAIT (e.g., Long Island Sound). (2) (verb) To measure the depth of the water.

SOUNDING
A measured depth of water. On hydrographic CHARTS the soundings are adjusted to a specific plane of reference (SOUNDING DATUM).

SPL (SOUND PRESSURE LEVEL)
A ratio of one sound pressure to a reference pressure.

SPL = 20 log (L/Lr) dB   where Lr is the reference pressure

STILL-WATER LEVEL (SWL)
The surface of the water if all wave and wind action were to cease. In deep water this level approximates the midpoint of the wave height. In shallow water it is nearer to the trough than the crest. Also called the UNDISTURBED WATER LEVEL.

STOCKPILE
Sand piled on a beach foreshore to nourish down drift beaches by natural littoral currents or forces. See FEEDER BEACH.

STONE
Quarried or artificially-broken rock for use in construction, either as aggregate or cut into shaped blocks as dimension stone.

STORM SURGE
A rise above normal water level on the open coast due to the action of wind stress on the water surface. Storm surge resulting from a hurricane also includes that rise in level due to atmospheric pressure reduction as well as that due to wind stress.

SURGE
(1) The name applied to wave motion with a period intermediate between that of the ordinary wind wave and that of the tide, say from ½ to 60 min. It is low height, usually less than 0.9 m (3 ft). (2) In fluid flow, long interval variations in velocity and pressure, not necessarily periodic, perhaps even transient in nature. (3) see STORM SURGE.

SURVEY, TOPOGRAPHIC
A survey which has, for its major purpose, the determination of the configuration (relief) of the surface of the land and the location of natural and artificial objects thereon.

SWELL
Wind-generated waves that have travelled out of their generating area. Swell characteristically exhibits a more regular and longer period and has flatter crests than waves within their fetch (SEAS).

T

TIDE
The periodic rising and falling of the water that results from gravitational attraction of the Moon and Sun and other astronomical bodies acting upon the rotating Earth. Although the accompanying horizontal movement of the water resulting from the same cause is also sometimes called the tide, it is preferable to designate the latter as TIDAL CURRENT, reserving the name TIDE for the vertical movement.

TOPOGRAPHIC MAP
A map on which elevations are shown by means of contour lines.

TOPOGRAPHY
The configuration of a surface, including its relief and the positions of its streams, roads, building, etc.

TOTAL DISSOLVED SOLIDS (TDS)

Compounds in the water that cannot be removed by a traditional filter and are made up of salts or compounds which dissociate in water to form ions.

TOTAL PETROLEUM HYDROCARBON (TPH)
A mixture of chemicals made mainly from hydrogen and carbon.

TOTAL SUSPENDED SOLIDS (TSS)
Solid materials, including organic and inorganic, that are suspended in the water.

TROPICAL CYCLONE
See HURRICANE

TROPICAL STORM
A tropical cyclone with maximum winds less than 34 m/sec (75 mile per hour). Compare with HURRICANE (winds greater than 34 m/sec).

TSUNAMI
A long-period water wave caused by an underwater disturbance such as a volcanic eruption or earthquake. Also SEISMIC SEA WAVE. Commonly miscalled "tidal wave."

TURBIDITY
(1) A condition of a liquid due to fine visible material in suspension, which may not be of sufficient size to be seen as individual particles by the naked eye but which prevents the passage of light through the liquid. (2) A measure of fine suspended matter in liquids.

U

UPSTREAM
Along coasts with obliquely approaching waves there is a longshore (wave-driven) current. For this current one can define an upstream and a DOWNSTREAM direction. For example, on a beach with an orientation west-east with the sea to the north, the waves come from NW. Then the current flows from West to East. Here, upstream is West of the observer, and East is DOWNSTREAM of the observer.

That molecular property of a fluid that enables it to support tangential stresses for a finite time and thus to resist deformation. Resistance to flow.

W

WATER DEPTH
Distance between the seabed and the still water level.

WATER LEVEL
Elevation of still water level relative to some datum.

WAVE
A ridge, deformation, or undulation of the surface of a liquid.

WAVE CLIMATE
The seasonal and annual distribution of wave height, period and direction.

WAVE HEIGHT
The vertical distance between a crest and the preceding trough. See also SIGNIFICANT WAVE HEIGHT.

WAVE PERIOD
The time for a wave crest to traverse a distance equal to one wavelength. The time for two successive wave crests to pass a fixed point. See also SIGNIFICANT WAVE PERIOD.

WAVE TRANSFORMATION
Change in wave energy due to the action of physical processes.

WETLANDS

Lands whose saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities that live in the soil and on its surface (e.g. Mangrove forests).

WIND SETUP

On reservoirs and smaller bodies of water (1) the vertical rise in the still-water level on the leeward side of a body of water caused by wind stresses on the surface of the water; (2) the difference in still-water levels on the windward and the leeward sides of a body of water caused by wind stresses on the surface of the water. STORM SURGE (usually reserved for use on the ocean and large bodies of water).